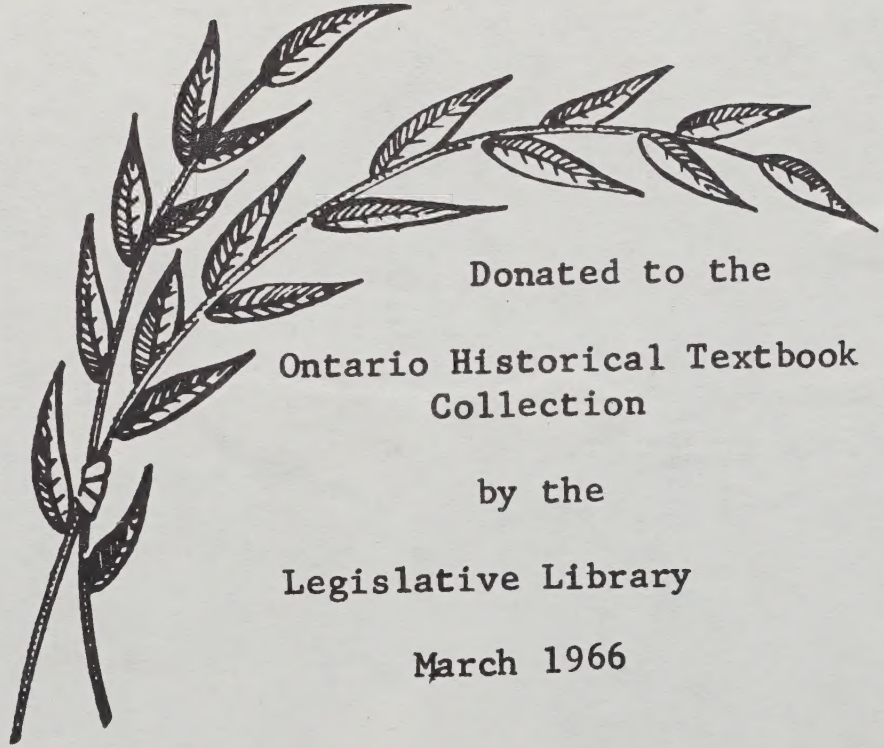
1913

ONTARIO DEPARTMENT OF EDUCATION

PUBLIC SCHOOL MANUALS.

MANUAL TRAINING.

OHEC
375
.00971
059DE\O
v.13



Donated to the

Ontario Historical Textbook
Collection

by the

Legislative Library

March 1966

ONTARIO
DEPARTMENT OF EDUCATION

PUBLIC SCHOOL MANUALS

MANUAL TRAINING

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed and Published by L. K. CAMERON, Printer to the King's Most Excellent Majesty
1913

cop 1913

ONTARIO
DEPARTMENT OF EDUCATION

PUBLIC SCHOOL MANUALS

MANUAL TRAINING

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed and Published by L. K. CAMERON, Printer to the King's Most Excellent Majesty
1913.

NOTE

This manual is the property of the Board of School Trustees and is intended for the use of teachers only, and not of the pupils.

(Name of Board of Trustees)

If a copy is desired by the teacher, it can be obtained at the Department of Education, Toronto, for 25 cents.

745.507
1913
ONT
copi

Copyright Canada, 1913, by
THE MINISTER OF EDUCATION FOR ONTARIO

DEPT. OF EDUCATION
HISTORICAL COLLECTION

PREFACE

This hand-book is intended to assist in teaching the work in manual training outlined in the Course of Study for Forms I-IV. It includes only such work as can be done, under the supervision of the grade teacher, in the class-room at the ordinary school desk. The work of the higher grades requires a complete equipment of benches and tools and is left to specially trained teachers.

It will be noticed that the work for each Form is intended to cover two years of school life. Much more is included than can be accomplished in the limited time generally available; but this is done for the following reasons:

1. To offer a variety of choice both to the teacher and to the pupils. Exercises voluntarily chosen are usually better done than those prescribed.

2. To offer suggestions for home work. Experience has shown that the pupils are willing and anxious to do work of this kind outside school hours. Every encouragement should be given them to do this.

It should be remembered that this manual is not a text-book nor does its use render it unnecessary to consult the various reference books mentioned.

No teacher can successfully teach the work of his grade unless he knows thoroughly the work of the preceding grades. Before undertaking the work of any grade the teacher should read carefully the chapters on "Materials and Equipment" and "Suggestions to Teachers."

Work in different materials should be taken concurrently. For instance, it is neither necessary nor advisable to complete the work in plasticine or clay before commencing that in paper. Many of the pupil's ideas will call for the use of all the materials in order that the fullest expression may be given.

It has not been considered necessary to state specifically at each stage the advantages to be gained from the introduction of this work. These are assumed, and the teacher who wishes to see them stated can consult the numerous references given.

INTRODUCTION

The old idea that education was entirely a matter of books is rapidly disappearing; and a system which appealed almost entirely to the memory is being supplemented by methods which directly appeal to the interests of the pupil and which use his own activity and observation in the training process.

These methods have received recognition in the Kindergarten and, if the work is useful there, it should be continued throughout the primary school.

It can hardly be questioned that the use of concrete material has a real and practical value in the training of the mental faculties. The pupil's conceptions of form, space, proportion, and extent are broadened and made real.

In dealing with *things* the pupil learns to know and appreciate the "perfect thing." He soon arrives, under judicious and intelligent leading, at the stage when he will reject his own work if it be not up to his ideal. The formation of this ideal is in the hands of the teacher.

When a pupil reaches this stage, some progress has been made in that process of character building which should be an aim of all true educational effort. He learns a fact of which many workmen seem ignorant, that one inch means one inch and not a sixteenth over or under; and a habit of accuracy is inculcated, which will permeate all his work whether in or out of school. Patience, concentration, and application are cultivated; and these are all desirable elements in the character of boy or girl.

Elementary manual training "is not to be thought of as giving practice in processes only; it is work capable of being developed to the mental, manual, and social benefit of the pupil. To confer these benefits it must lead the child to think out processes intelligently and help him to see the relations which his work bears to other school work. It must be work which will give him technical skill and develop creative power; it must lead him to take an interest in the construction done in the outside world."

The main object of this work is mental development and physical control. The making of things should be subsidiary to the thought processes involved, and the exercises should sustain the pupil's interest and take advantage of his natural desire to construct. Manual Training should make the ability to do, a part of the knowing process, and should combine theory with practice. The amount of work accomplished is unimportant in comparison with the mastery of correct methods and the formation of good habits.

Every opportunity should be given to the pupils to modify given type models or to design new ones, and to rearrange given units or create new combinations. All the work should have in it the elements of beauty of construction, harmony of proportion, and appropriateness of decoration. Though we may not be able to add to the quantity or the variety of the material, we can modify its form; and we can arrange it in new combinations. The making of new forms and combinations, the giving of definite expression to ideas and mental images, the rendering of the inner outer, is the great Froebelian doctrine of creativeness.

One of the most important aspects of this work is that known as correlation. Elementary Manual Training should be regarded less as a subject than as a method of approach to subjects in the curriculum. This should be emphasized wherever possible. Reading, writing, arithmetic, geography, history, nature study, drawing, and science can all be used in this connection. Lessons so chosen not only give manual dexterity, physical control, and ability to do, but also serve to make the instruction more real.

It cannot be too strongly insisted upon that every manual training lesson should be related directly either to some other phase of school work or to the vital interests of the pupil in the home, the playground, or the industrial life around him.

MANUAL TRAINING

PUBLIC SCHOOL COURSE OF STUDY

(DETAILS)

FORM I

I. *Modelling*:

1. Free modelling. Pupils should be encouraged to express freely their own ideas in plasticine, clay, or sand; to illustrate stories, and to invent forms and patterns for themselves.

2. Representation of objects as oranges, apples, nuts, vegetables, pet animals, loaf of bread, dishes, etc.

II. *Paper Cutting, Tearing, and Folding*:

1. Cutting out pictures from newspapers, catalogues, etc.; free cutting of objects in which the child is interested, for example, leaves, flowers, fruits, pet animals, vehicles, toys, tools, etc. The subjects chosen for free cutting may be connected with special days or seasons; for example, lily, rabbit, chicken for Easter; trees for Arbor Day; stockings, bells, Santa Claus for Christmas.

2. Assembling and mounting of objects cut, in groups to illustrate scenes, imaginary stories, or stories from the Primer and the First Book.

3. Folding simple geometric forms, such as square, rectangle, triangle, and the use of these as elements in the formation of patterns and designs.

4. Paper cutting and folding to make objects based on the above forms; for example, boxes, chairs, beds, carts, houses, sleds, baskets, tents, wall pockets.

III. *Weaving*:

1. Mat weaving in paper.

2. Weaving on simple loom with such materials as raffia, wool, yarn, string, pieces of clean rags.

3. The making of objects from coarse canvas; for example, needle-cases and book covers, using various stitches to form patterns for decoration.

FORM II

I. *Clay Modelling*:

1. Free expression work as in Form I, making special use of geography, history, and nature study; for example, land and water formations, scenes in connection with early discoveries and pioneers, animals and insects, fruits, common objects.

2. Modelling from memory, using well-known objects as bottle, small bowl, birds' nests, animals, hats, etc.

II. *Paper Cutting and Folding*:

1. Paper cutting and mounting—the work of Form I continued—illustrating games, occupations, seasons and days, common land and water forms, historical facts.

2. Geometrical forms used as units in building up patterns and borders.

3. Advanced work in paper folding including the construction of geometric figures, units for design, and objects more complex than those attempted in Form I—such as snow-flakes, stars, crosses, wall pockets, boxes, baskets, windmill, simple furniture.

III. *Cardboard Modelling*:

1. Simple exercises in light-weight cardboard similar to those already made in paper, distances obtained previously by folding being now obtained by measurement.

2. Geometrical construction of the square, rectangle, and circle, and the making of trays, boxes, baskets, wall pockets, and other objects based on these forms. At this stage simple appropriate designs may be used in the decoration of the objects made.

3. Mounting pictures, giving attention to suitable arrangement, and harmony of colour between the picture and the mat.

FORM III

I. *Clay Modelling*:

1. Modelling of natural objects requiring greater detail.
2. Simple pottery.
3. Relief maps in clay or other plastic material.

II. *Paper*:

Illustrating by free cutting, as in Form II; special days and seasons, games, historical and geographical concepts, decorations, borders, scrap-books; the work to be more advanced.

III. *Cardboard Modelling*:

Geometrical construction of the triangle, hexagon, and octagon, and the making of objects based on them.

IV. *Mechanical Drawing*:

1. Use of ruler, set-squares or triangles, compasses.
2. Simple geometrical problems applied to cardboard construction.
3. Construction of, and working to scales of ½, ¼, ⅛.
4. Simple plans and elevations lettered and dimensioned; for example, plans of school-rooms, tool sheds, school gardens, etc.

V. *Work in Thin Wood*:

1. One piece models; for example, plant label, key rack, pencil sharpener, geometric forms, clay modelling tools, printing blocks.

2. Two or more piece models; for example, windmill, weather-vane, boat, bracket, plant ladder, boxes, toys, gates, fences, and work with strips.

FORM IV

I. *Clay Modelling*:

Modelling of a more difficult character than in Form III may be continued—relief maps, modelling from nature, and from memory.

II. *Cardboard Work*:

Bound and covered exercises, mats in geometrical shapes, pen and ink trays, stationery boxes, napkin-rings, jewel boxes, objects based on the cube, cylinder, cone, and pyramid.

III. *Bookbinding*:

1. Loose-leaf books for pictures, photographs, or newspaper cuttings.
2. Simple repairs to damaged books, mending torn pages, re-inserting loose leaves.
3. Portfolios.

IV. *Mechanical Drawing*:

The work of Form III continued and extended to include simple geometrical problems required in preparing working drawings; practical methods of drawing the ellipse and the ellipse in a rectangle.

V. *Wood-work*:

The knife work of the previous grade continued and extended with much greater stress on the mechanical drawing.

Simple objects or elementary apparatus required in the school, playground, or home discussed—shape, size, materials obtainable, and methods of construction considered, drawings made, and the pupils encouraged to make the articles at home; construction of cupboards from packing cases, tool racks, and simple school and household repairs. Where properly equipped rooms are not available, much good and useful work can be done if one or two benches are supplied. Every school should have at least one bench with a set of tools. Where space is limited, this may be built along one wall.

MATERIALS AND EQUIPMENT

PLASTICINE

Plasticine, which is an antiseptic material, can be obtained from any dealers in school supplies. It is sold in one pound cartons. Plasticine being of a greasy nature, should never be used on any absorbent material such as paper or unvarnished wood. It retains its plastic condition for a long time, but if it should become a little too hard to work comfortably, it can be softened as follows:

Press or roll out into thin flat sheets, smear with a *little* vaseline, roll up, squeeze and work with the hands until it is soft to the touch.

Colours—gray, green, brick-red, yellow, blue, and white, at 30c. a pound. One pound will provide sufficient material for six pupils.

Grease-proof boards, at 35c. a dozen. Any grease-proof surface can be used to model on. Wooden boards varnished, tin, or table oil-cloth will serve the same purpose. A bread or biscuit tin is useful for storing.

CLAY

This can be obtained:

(*a*) In powdered form known as clay flour, at 5c. per lb; (*b*) in 5 lb. cartons, at 25c. each; (*c*) in 5 lb. bricks, at 25c. each; (*d*) from most potteries and brickyards ready for use at about $2.00 per 100 lb.; (*e*) from natural clay beds.

OTHER EQUIPMENT REQUIRED

Sheets of paper or pieces of table oil-cloth to protect the tops of the desks.

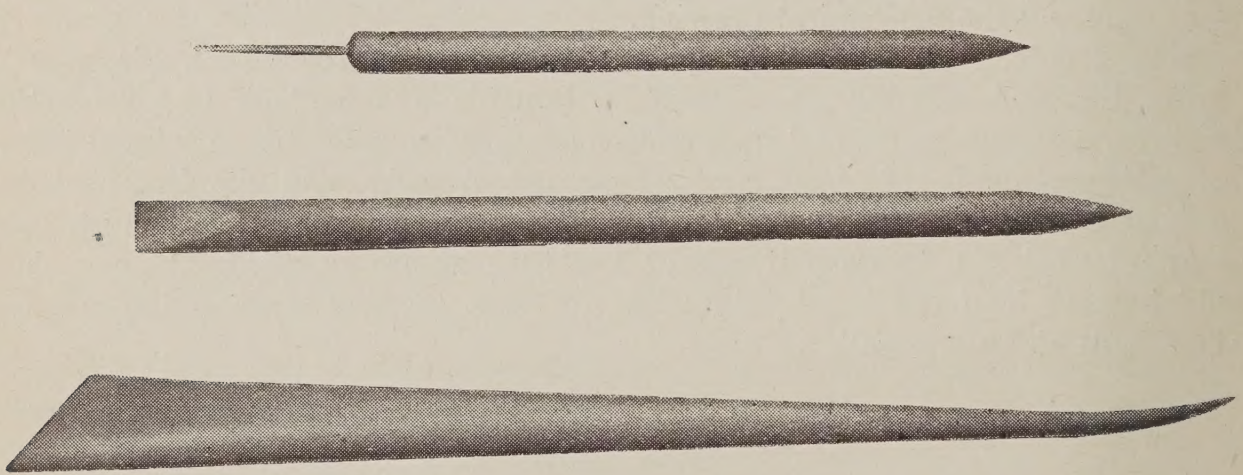
Modelling boards, about 12 in. x 12 in., of pine or bass-wood, with ends secured by cleats to prevent warping; ten cents each.

In place of these, school slates, sheets of heavy brown paper, or pieces of table oil-cloth may be used.

TOOLS

The fewer tools the better. When special shapes are required the pupils can generally make them from small pieces of wood.

The accompanying cut shows good general tools which cost ten cents each.



A small piece of No. 3 rattan or a common match stick is often of great service. A wooden mallet in the form of an ordinary potato masher, a wooden spatula, small sponges, and dusters are also required.

If no wash bowl is convenient, a small pail to contain water will be necessary.

STORING CLAY

The following may be used, each being provided with a cover to prevent evaporation:

A zinc-lined wooden box with two divisions, an earthenware vessel, or an enamelled vessel.

STORING CLAY MODELS

In more advanced work where it is necessary to keep uncompleted objects from lesson to lesson, they must be covered with a damp cloth. Biscuit tins make good receptacles for small models, but a zinc-lined cupboard is the ideal.

MIXING CLAY FLOUR

Clay flour may be mixed with water and kneaded like ordinary dough. When the mixture ceases to be sticky it is in good condition. For large quantities it is best to begin the mixing at least a full week before the material is required.

1. To mix 100 lb. of clay put seven or eight quarts of water into the clay box, and into this sprinkle and stir the clay flour until the mixture becomes too stiff for further stirring.

2. Leave the box lid open, to allow the superfluous water to evaporate.

3. Each day, take a large wooden spatula and toss the clay about in the box, leaving the surface as uneven as possible to encourage evaporation.

Clay so prepared is kept in good working condition by keeping a damp cloth spread over it.

TO PREPARE CLAY FROM A NATURAL CLAY BED

Good clay is found in some localities, but it is almost sure to contain grit or other impurities. To remove these, mix the clay thoroughly with water, until it is reduced to the consistency of cream. The heavy matter, stones, etc., will settle quickly to the bottom. Pour the remainder through a piece of coarse sacking, allow it to settle, pour off the water, and spread out the sediment to dry. This sediment may be treated in the manner recommended for bringing clay flour to a proper consistency. More washings and finer sieves will produce finer clay.

In some districts it may be possible to obtain clay fairly free from grit and other impurities. In such cases it may not be absolutely necessary to follow the above method, but all clay taken directly from the natural bed is improved by such treatment.

TO KEEP CLAY IN GOOD CONDITION

At the end of the lesson all waste clay should be returned to the division of the box specially provided for it, and pounded with a mallet. A damp cloth should be then spread over it and the lid closed.

To bring dry, hard clay back to a plastic condition it should be broken into fairly small pieces and packed as closely as possible in one division of the clay box or in an ordinary pail or crock. Sufficient water should then be poured in to barely cover the clay. Allow it to soak for a day or two, stirring occasionally. This will produce a soft clay which can be brought to a proper consistency by the method described in mixing clay flour.

MODELLING MIXTURES FOR PERMANENT OBJECTS LIKE RELIEF MAPS

1. Salt and Flour:

Enough flour to bind the salt is all that is necessary. A simple combination is about half of each mixed with water to the consistency of putty or stiff dough. This gives a beautiful, clean, modelling material which dries white, and takes colour well.

2. Sawdust and Flour:

About equal proportions mixed with water give another material very suitable for relief maps. This makes a mixture many times harder than the wood from which the sawdust was obtained. The colour will depend upon the sawdust used, and the texture upon its fineness or coarseness.

HINTS ON WORKING CLAY

The clay should be handled as little as possible, as owing to the heat of the hands it soon loses its plasticity, and breaks and crumbles when an attempt is made to press it into the desired shape. Clay in that condition is useless, and should be returned to the box.

The greater portion of the modelling should be done with thumb and fingers. The thumb, being more sensitive than the fingers, is the most important tool used.

Flat shells, leaf forms, or similar thin objects which are built up in the solid on a slab, often require undercutting to give the effect of thinness. This effect can be accomplished by cutting away a portion of the backing or supporting clay, so that when viewed from the position in which it was modelled no backing clay would be seen, but only the edge of the leaf or shell.

Clay work should be built up by adding small pieces. The purpose is to get the clay, forming the model, to an even consistency; for clay shrinks considerably during drying. If this is not attended to, the model will shrink unevenly, and so be out of shape when dry.

ARMATURES

If the clay is to be fired, no other substance must be used in building up the models, as owing to the unequal contraction of different substances the models would break whilst in the oven. If the models are to be cast in plaster, or to be allowed to dry naturally, it is often an advantage, and sometimes a necessity, to build the model round a framework or skeleton in order to give greater solidity to the whole, and particularly to the slender parts. For instance, if one were modelling a small human figure with outstretched arm, it would be necessary to model that arm round a piece of wire or wood, which would in its turn require to be fastened to some support within the body of the model. Such internal supports are called armatures.

SAND TABLES

These can be purchased from any dealer in school supplies. They are generally 6 feet long, 30 inches wide, and 24 inches high, and cost $22.50.

Tables or Trays, of a cheaper kind, may be made:

1. By putting a rim, about 1 inch thick and 2 inches or 3 inches deep, round the top of an ordinary kitchen table, and shortening its legs. It would be improved if lined with zinc.

2. By putting a rim (as above) on a board of the desired size. A good lid or side of a packing case will serve. Line the board with zinc if possible. It can be used over a couple of desks or on ordinary trestles, and stored away when not in use.

3. A large bread pan or tray may be used for smaller work.

4. In summer time a load of sand in a corner of the playground will serve.

TO WASH SAND

Put the sand in a pail or tub, pour on plenty of water, and stir. The clay, humus, and other impurities can be poured off when the sand settles. Continue this until the water is clear. Where available, run a gentle stream of water from a hose into the tub and keep its contents well stirred. Continue until the overflow runs clear.

Washed sand may be purchased from dealers in builders' supplies.

PAPER WORK

Engine-coloured paper:

4 in. x 4 in. at 12c. a packet of 100 sheets.
5 in. x 5 in. at 15c. a packet of 100 sheets.
Large sheets 22 in. x 28 in. at 3c. a sheet.
Other sizes cut to order.

These packets may be obtained in (*a*) assorted colours, (*b*) tints of standard colours, (*c*) standard colours, (*d*) shades of standard colours, (*e*) neutrals and grays.

Tinted Drawing, Construction, and Mounting Paper:

This is a heavy paper made in 20 colours.

6 in. x 9 in., one colour in packet at 15c. a packet of 100 sheets.
9 in. x 12 in., one colour in packet at 30c. a packet of 100 sheets.
12 in. x 18 in., one colour in packet at 60c. a packet of 100 sheets.
Single sheets, 24 in. x 36 in. at 2c. each.

Heavy Folding Paper:

6 in. x 6 in. cover paper, six colours, assorted at 20c. a packet of 100 sheets.

7 in. x 7 in. medium weight cover paper, six colours assorted at 30c. a packet of 100 sheets.

Cover papers of various weights and qualities may be obtained in large sheets. Dull brown or gray wrapping paper for mounts and construction work varies in price according to size, weight, and quality.

The above sizes and descriptions are those used by dealers in school supplies, from whom material and sample books of the various colours may be obtained.

PASTES

To about one quart of ordinary flour paste add about half an ounce of gum tragacanth dissolved in water, a teaspoonful of powdered alum, and a few drops of oil of cloves, formaldehyde, or carbolic acid to prevent souring.

Another paste may be made by adding a tablespoonful of gum tragacanth to a pint of cold water. After standing for ten or twelve hours this will be of the consistency of jelly. Stir in a few drops of oil of cloves and it is ready for use.

To make a strong flexible paste suitable for cardboard and bookbinders' cloth, add liquid glue to ordinary flour paste in the proportion of one third glue to two thirds paste.

Paste may be purchased in the powdered form at 15c. a pound, and in small pots at 5c. and upwards.

OTHER MATERIALS OFTEN USED IN CONNECTION WITH PAPER AND CARDBOARD

Toothpicks; pea sticks; paper fasteners; tying materials, such as coloured string, wool, raffia, twine, ribbon, etc. Ingrain wall-paper is often useful for making long mounts, or for other cuttings.

Rules may be purchased at 5c. up, and scissors at 25c. up.

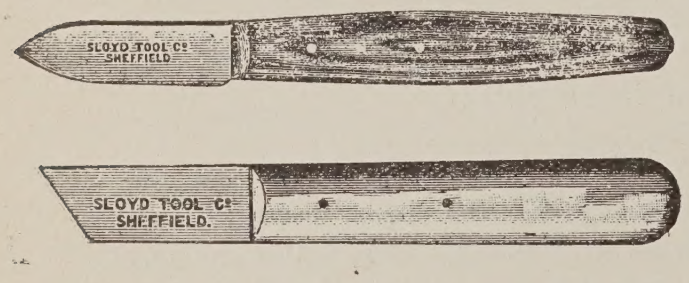
CARDBOARD CONSTRUCTION

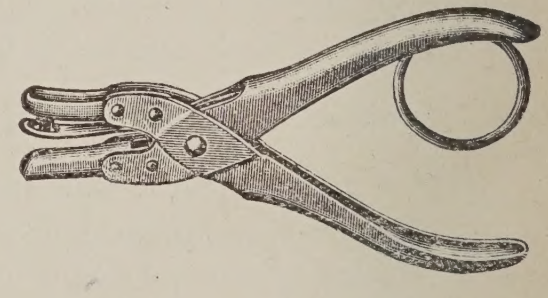
Tinted Bristol-board, 22 in. x 28 in. at $3.50 a hundred sheets.

Pulp boards, size 20 in. x 30 in., at $1.50 a bundle. The thicker the board, the fewer sheets in the bundle.

Mill-boards are sold in similar bundles at $2.00 a bundle. These are intended for cutting boards, and should be ordered cut to the required size.

Bookbinders' cloth will average 25c. a yard. This cloth ready gummed up to 3 in. may be purchased at $1.50 a roll according to width.





Cardboard knives at $3.00 a dozen.

Ticket punches at 35c. each.

Scissors, 6 in., from about $4.00 a dozen.

Leather punches at 15c. each.

Set-squares from 75c. to $1.80 a dozen pairs.

Eyelets (No. 18) in boxes of 1,000 at 35c.

Shoemakers' eyelet punch No. 10 at 30c.

Eagle pencil compass No. 576 at $1.80 a dozen, and an ordinary H drawing pencil.

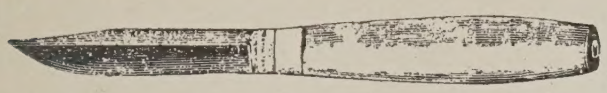
Flat rulers graduated in 1 in., ½ in., ¼ in., and ⅛ in. A brass strip let into the lower edge is advisable to protect the rule from injury when cutting or scoring.

Other fastening materials, such as raffia, wool, string, and paper fasteners.

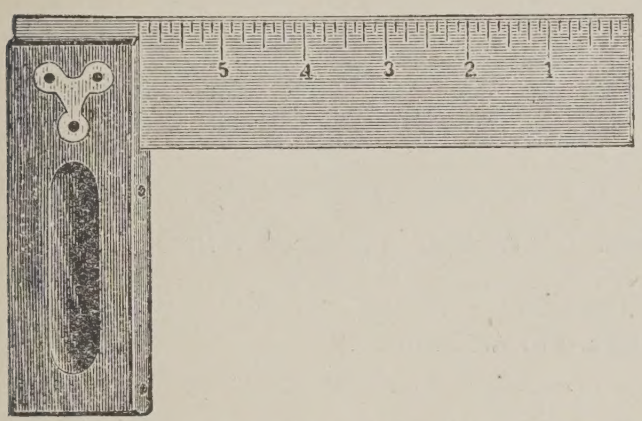
General class box for storing the materials when not in use.

THIN WOOD

Individual Tools:

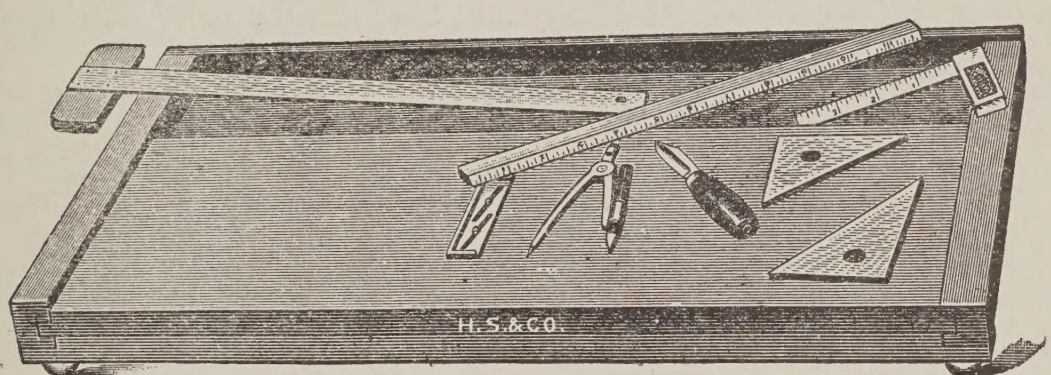


A knife, 30c. In case satisfactory knives are not available, the pupils might be allowed to use their own pocket knives, but this practice is not to be recommended.

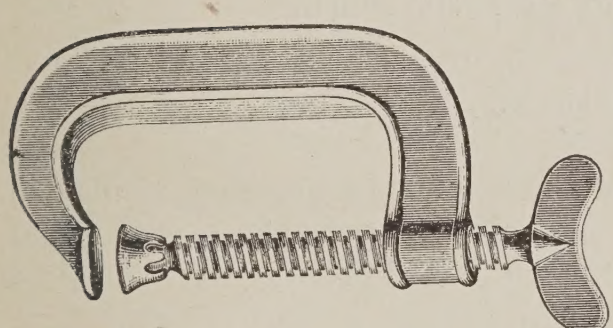


A ruler of good quality.
A 6-inch Try square 25c.

Mill-board to protect the top of the desk when a special tray is not used.



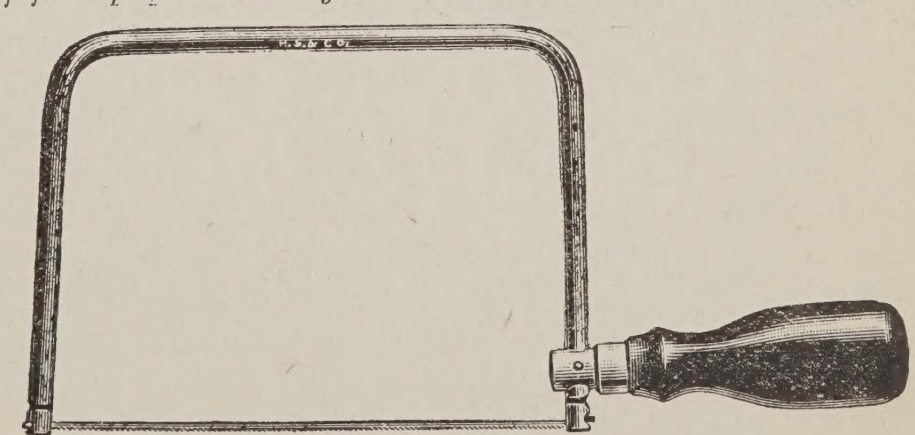
A Desk Tray



A small clamp for holding work to tray or desk, 10c. to 25c.

Tools, etc., for a group of four pupils working at one time:

A small Hammer @ 10c
An 8 inch Back-saw @ $1.00



A Coping-saw @ 35c.

General Tools:

Oil-stone from 50c., up.
Oil-can No. 1 at 15c. It holds 3 ounces.
Oil-can No. 2 at 18c. It holds 5 ounces.
Six-inch wood files; various shapes at about 15c. each.
Liquid glue at 60c. a pint.
Fine brads or finishing nails at 20c. a pound.
Fine flat-head nails at 20c. a pound.
One dozen assorted Brad-awls.
Sand-paper No. 1, at 29c. a quire.
Thin wood (prepared) 3-16 inches and 1-8 inches. (Bass or Whitewood)

CYANOTYPE, OR BLUE PRINT PROCESS

To Make Blue Print Paper:

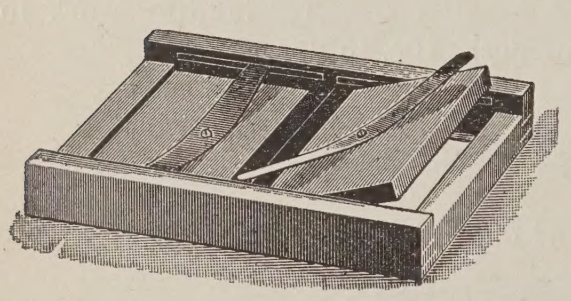
Take a white paper of good quality and coat it with the following solution:

A.	Citrate of iron and ammonium	2	ounces
	Water	8	ounces
B.	Ferricyanide of potassium	1¼	ounces
	Water	8	ounces

Mix equal parts, immediately before use, and float the paper upon the solution for three minutes; hang up the paper to dry in a dark, dry place. The solution may also be put on the paper by means of a tuft of cotton.

Instead of making the paper as above described it may be purchased, cut to size, from dealers in photographic goods and architects' supplies.

THE PRINTING-FRAME



A frame must be provided, similar to those used in photographic printing and large enough to hold the drawing flat against the glass.

As a substitute for the regular printing-frame, a good wooden picture-frame may be used; provided some means are employed to ensure that the copy and the blue print paper are well pressed against the glass, and that arrangements are made to examine the print without disturbing it.

Another simple printing-frame may be made by taking two pieces of glass, dividing one of these into two, and hinging these two together by means of passe-partout or bookbinders' cloth. After the blue print paper and drawing are in position, these two sheets of glass can be held in place by means of an elastic band.

The drawing, which takes the place of the negative in photographic work, must be inked in on good tracing paper or cloth, and all lines not wanted in the blue print should be omitted.

Place the drawing with the lines against the glass; place over it the blue print paper, sensitized (yellow) side down; fix the back of the frame so that the drawing and the blue print paper are firmly pressed against the glass; expose to direct sunlight if possible. Continue the exposure until the blue print paper assumes a reddish lavender colour. This signifies that the action of the light is complete. Wash the print thoroughly, preferably under running water, and hang it up to dry.

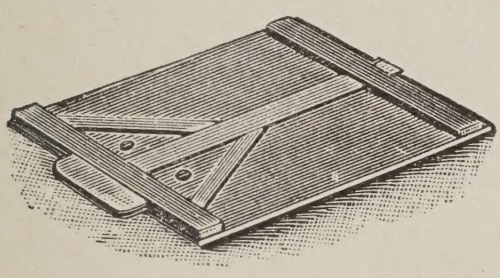
Great care must be exercised when examining the print not to disturb its position. (See Plate 38, p. 149)

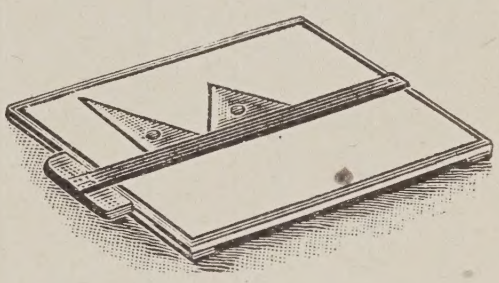
GENERAL WOOD-WORK

One bench, detached if space permits, or attached to the wall. $8.00 to $10.00. (See diagram, p. 18.)

Bench Tools:

Bench hook @ ..... 25c.
Marking Gauge @ ..... 25c.
Jack-plane, Stanley No. 5, @..$2.50
Small Back-saw, 12 inches, @.$1.00
Knife @ ..... 30c.
Glass-cutter @ ..... 25c.
Pencil compass, Eagle No. 576
Rule, 1 foot, @ ..... 25c.
6-inch Try square, @ ..... 25c.
3 Firmer chisels, 1 inch, @.. 57c.
½ in. @ 46c., and ¼ in. @ ... 42c.
Bench whisk or brush.





No. 2 Drawing Kit @ ..... 60c.

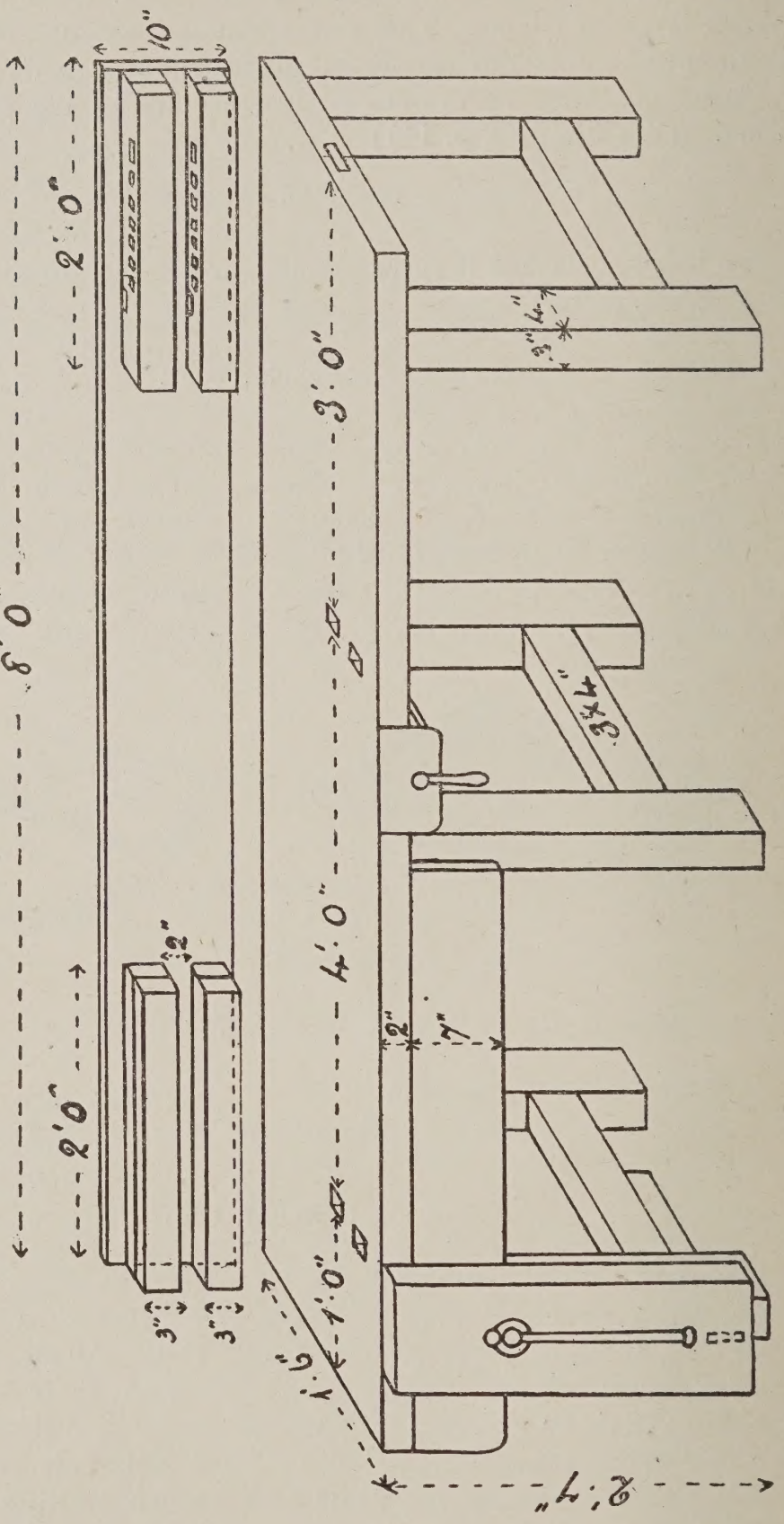
Tools for four pupils working at one time:

No. 4 Bailey smoothing-plane @ $1.60
Claw hammer, 13 ounces, @.. 55c.

GENERAL TOOLS

1 ea. Wood and Metal Countersinks, @ ..... 30c.
4 Brad-awls (assorted) @ .. 25c.
1 Mortise Gauge, @ ..... 50c.
1 pair Wing Dividers @ ..... 25c.
1 Pad or keyhole saw @ .... 25c.
1 Handsaw, 22 inches, @ $1.65
1 Rip-saw 22 inches @ $1.65
1 Mallet @ ..... 25c.
1 Oil-can ..... 25c.
1 Oil-stone @ $1.00
1 12-inch Try square @ 50c
1 8-inch Swing Brace @ $1.10
1 Set Auger Bits in eighths from ¼ inch to 1 inch @ ..$2.50
1 Bevel, 8 inch, @ ..... 25c.
2 Nail Sets @ ..... 10c.
1 pair Cutting Pliers @ ..... 75c.
1 Screw-driver, 6 inch, @.... 35c.
1 Screw-driver, 10 inch, @ .. 60c.
1 Monkey-wrench @ ..... 50c.
1 Chest or Cupboard for holding the general tools.

BENCH, FIXED TO THE WALL OF CLASS ROOM, FOR TWO PUPILS.
THIS MAY BE TAKEN AS REPRESENTING TWO UNITS, WHICH MAY BE INCREASED INDEFINITELY, ACCORDING TO THE SPACE AVAILABLE.



RAFFIA AND OTHER MATERIALS

Raffia is the outer cuticle of the leaves of the Raphia Ruffia palm, which is stripped just as the leaves are about to open. It grows in Madagascar and is largely used by the natives for making hats, mats, ropes, bags, screens, etc. It is a tough, fibrous material and can be used either alone as in mats, woven or knotted bags, soft coiled baskets, hats, cushions, braids; or in combination with other materials as with cardboard, for foundations for serviette rings, mats, boxes, pin-cushions, etc.; or with rattan for Indian baskets, and rings.

Natural Raffia may be purchased at 25c. a pound, and coloured Raffia at 50c. a pound. Wool, soft cord, carpet ravellings (washed), strips of clean rags, yarn, dried grasses, etc., may often be used with advantage in weaving various articles.

DYEING

Raffia being a vegetable substance requires a cotton dye. Use packet dyes and follow the directions closely. Full particulars as to mordants, etc., are printed on the packets.

FORM I

FREE EXPRESSION

The child's first day in school is a critical period in his history. He comes from the freedom of the home or the organized play of the kindergartens. The teacher should strive to make the change as imperceptible as possible. The previous activities of the home and the rational occupations of the kindergarten must be vitally connected with the more formal instruction of the school.

It has been said that "when the child goes into the school-room he has to put out of his mind a large part of the ideas, interests, and activities that predominate in his home and neighbourhood." It is the business of the teacher to make use of these interests and activities, not with the mere desire of making the work entertaining and pleasant but because these interests and activities offer a point of contact, and afford the only sure and satisfactory foundation for the work which is to follow.

For this purpose, use should be made of all available material such as sticks, twigs, splints, straws, rushes, shoe pegs, blocks, cubes, discs, beads, pictures, catalogues, clay, plasticine, sand-table, coloured paper, crayons, pieces of cardboard, cardboard boxes, toys, cord, string, spools, pins, paper fasteners, raffia, corks, canvas, needles, thread, scissors, doll's house, old packing cases, etc.

All these objects may be readily collected by the resourceful teacher. The sticks may be purchased or made by some of the older pupils or by the teacher. Blocks should be cut the length of the sticks required (an exact number of inches) from a straight-grained piece of white cedar. These should be split into uniform size and each child given a certain number of sticks which he may keep in a box in his desk. The educational value and interest of the work is increased if sticks of several lengths are used. Splints, such as are used by the Indians in basket making, may be made from the black ash.

The discs may be cut from old cardboard boxes by the use of a common wad-cutter such as is used in cutting wads for a gun (No. 10 or 12), or by a three-quarter inch leather punch. These discs may be best cut by using the cutter on the end of a block of green wood, as this is less likely to turn the edge of the cutter.

The child's formal introduction to school life should be through the use of concrete material and objects. Every page of the Ontario Primer suggests preliminary work of this character with the various materials mentioned. At first the teacher may suggest "what" but leave the "how" to the pupils. Later they will be ready and eager to suggest for themselves. At this stage the teacher should not be too much in evidence.

It cannot be too strongly insisted upon that here the imagination of the child must be allowed the freest play. The results may appear crude to the teacher but they mean something very real to the child and must be judged, at first particularly, from his standpoint. Free expression work suggested by the lessons in the Primer forms an excellent occupation for little children while the teacher is engaged with other classes.

Let us now examine a number of pages in the Ontario Primer and show how the ideas presented there may be specifically applied in free expression.

Page 6. Lay sticks to form a room. Cut a mat from coloured paper. Paste on to it a centre piece of another colour or colour the centre with crayon. Lay sticks on the mat to form patterns. Place the mat in position in the room. Cut the shape of the boy and girl from paper. Various letters and words may be made from sticks and then from rolls of plasticine or clay.

Page 7. Tops, hats, and caps may be cut and modelled. Show how, by folding on a vertical diameter, the tops and caps may be made symmetrical.

Page 8. Build a pen from sticks and corks or soaked peas. Model a nest full of eggs. Cut the tree from paper. Name the tree. Count the sticks and eggs.

Page 9. Cut the bell; model the well. Cut from paper of different colours, Long Tom Thin, Short John Stout, the little girl, and the cat; these may be cut from white paper and coloured with crayons.

Page 10. Model the cat and the dish. Use sticks for the legs and the tail of the cat. Cut a picture of a girl ringing the bell.

Page 11. Cut out letters in paper, and form them from sticks and from rolls of clay. Combine letters into words.

Page 12. Use sticks to form a shed. Cut the mat and fringe the edges. Model the cat asleep on the mat. Cut out a dress and colour it red. A picture showing the sun coming over the hill may also be cut.

Page 13. Model a hen, a goose, a nest and eggs. Cut the haystack and barn. Lay out a farmyard with sticks.

Page 14. Gather, cut, and colour maple leaves. Form borders. Cut birds flying and arrange a flock.

Page 15. Cut out the "Baker's Man" in paper. Model the cake. Make a letter B with small sticks and place it on the cake. Model the clock face in clay and scratch in the figures.

Page 16. Build a house with sticks or blocks. Model a garden and fence it with sticks. Set out plots with sticks. Use twigs for trees and plants. Cut the shape of the garden tools in paper—hoe, rake, spade. Cut or model a dog gnawing a bone.

Page 17. Cut and colour the three flags, using sticks for staffs. (For colours see frontispiece of the Primer). Exhibit the best work on the walls of the school-room.

Page 18. Make little books. Cut out a stove, cooking utensils, trees, coins. Cut discs and arrange them in a series. Colour some white and others blue.

Page 21. Cut pictures of the cow, tree, dog, and boy. Use different coloured paper, green for meadow, blue for sky, and black for clouds. Mount them in suitable positions. The teacher should show a poster of this kind and remove it from sight after the pupils have grasped the idea.

Page 24. Cut gong, fireman's hat, people running, horses, wheels, engines, etc.

Page 26. Cut and model squirrels, walnuts, butternuts, and beechnuts.

Page 32, 33. Cut paper dolls, old man, boy, baby. Cover a cent with a piece of white paper and rub with a soft pencil until the letters, etc., show through. Cut out and use the money thus made in buying and selling. Cut the sun and the moon.

The following stories in the Primer may all be graphically illustrated by the use of some of the materials mentioned: Christmas (p. 34), Little Jack Horner (p. 35), Humpty Dumpty (p. 36), The Cat and the Bird (p. 39), The Ducks and the Frogs (p. 40), The Dog in the Manger (p. 42), Jack and Jill (p. 43),

The Story of Henny Penny (p. 48), The House that Jack Built (p. 51), Little Bo-Peep (p. 54), Old Mother Hubbard (p. 56), The Gingerbread Boy (p. 62), Little Boy Blue (p. 68).

The work should be made as topical as possible. Young children always look forward with great anticipation toward times, seasons, and festivals. These can all be illustrated. For example:

Hallowe'en. Cut and colour pumpkins. (Plate 34, p. 145)

Thanksgiving. Lanterns, pumpkins, fruits, vegetables, turkey.

Autumn. Cut leaves and colour them with crayons.

Christmas. Bells, trees, stockings, Santa Claus, presents, decorations, lanterns, cards. (Plate 35, p. 146)

January. Calendars, snow-flakes, sled, toboggan, skates, snow man, Eskimo.

February. Valentines, winter sports. (Plate 33, p. 144)

March. Windmills.

April. (Easter). Chickens, rabbits, lamb (plate 32, p. 143), lily, snow drop, crocus, tulip, daffodil, hepatica leaf, umbrella, skipping, playing marbles.

May. Baskets, gardens, sprouting acorns and chestnuts. Plant peas and beans, etc., in window-boxes and model them at different stages of their growth, (Plate 1, p. 112), Empire Day, Arbor Day.

June. Birds' nests and eggs, growing plants, fruits, summer sports, camping.

MODELLING IN PLASTICINE

The best material to use in the lower forms is plasticine. It may be obtained ready for use and remains in workable condition longer than clay.

For a preliminary lesson give each pupil about one fourth of a roll of plasticine to "play with." This will give experience in handling and the pupil will soon begin to "make things." In this way he will discover how to make balls and flat discs, how to roll out long pieces, how easy it is to break off and to attach a piece wherever required. At a later period this self-discovered information will be made use of in giving expression to ideas received from various sources.

The following is the method adopted by a successful teacher in using this material:

First Stage:

Choose a simple story having well defined actions; for example, "Jack and Jill," "Tom, Tom, the Piper's Son," "Little Boy Blue." Tell the story simply and briefly with strong emphasis on the action. Have a few of the pupils "act" the story. Let the pupils then model any part of the story that appeals to them. The expression is to be entirely spontaneous and uninfluenced by any direction concerning methods of procedure. The pupils should be encouraged to talk about their models and to explain the significance of the various parts.

Second Stage:

Tell a story and let the pupils select a particular scene. Question definitely until they have formed a clear mental image. Direct the questions so that the pupils will observe comparative sizes, forms, characteristic features, and appearance in given positions either in rest or action.

The pupils then work without further direction. A language lesson should follow, in which some of the pupils are given an opportunity to explain their models to the remainder of the class. Pupils should be encouraged to criticise fairly the work of their fellows. (Plate 2, p. 113)

THIRD STAGE:

Give the pupils the plasticine with the simple direction, "Make anything you wish and, when you have finished, you may tell me the story."

The above method deals entirely with the free expression of the pupil's idea. It will, of course, be necessary, in order to secure definite results, to give definite instruction in the use and manipulation of the material.

Beads are amongst the easiest of the early manipulations of any plastic material, and an early lesson on their making is desirable. (Plate 3, p. 114)

A LESSON ON BEAD MAKING

MATERIALS:

Modelling boards, plasticine, blunt needles, or round toothpicks.

Show a string of beads and induce the pupils to tell how to make a similar string. How much plasticine is required to make a certain size of bead? About the size of the end of the teacher's finger, or some familiar object. Each child nips off a piece about that size. How shall we make this round? By rolling. Some have been made too flat. Why? When the small beads have been made, compare them with real beads. What more is required? A hole through the centre. How is this made? Question as to stringing.

If string is used, it should be of good firm quality. A piece of No. 3 rattan would be better. At this early stage the beads may be joined by small pieces of plasticine. At a later period a string of graded beads might be made or one of beads and discs alternately. Small beads of different-coloured plasticine may be pressed out flat and used to make many familiar things; for example, cakes, biscuits, dishes, buttons, etc. These may be used to form different number combinations, border designs, etc.

ROLLING PLASTICINE:

Another method of using plasticine in the Primary Forms is to form rolls of it, from which, in conjunction with the previous work, many objects can be made, such as letters, ropes, nails, hammers, anchors, chairs, rugs, bottles, bangles, candles, spectacles, dumb-bells, whips. (Plate 4, p. 115)

HOLLOWING:

Make a small ball, press it flat, then place it in the left hand and press it into the required shape with the thumb or finger of the right hand. With the addition of this simple manipulation to those already learnt, many other objects can be made, such as mushrooms, saucers, basins, cups, flower-pots, ink-wells, salt shakers, puddings in basins, sugar scoops, sauce-pans.

OBJECTS FROM THE BALL:

Objects formed from the ball, such as cherries, plums, apples, nuts, acorns, onions, pears, oranges, lemons, can be made at this stage. Wherever possible, have the real object in front of the pupils. Failing the actual object, good pictures or sketches are serviceable. Animal forms, such as snails, fishes, cats, dogs, rabbits, ducks, swans, mice, form good subjects. (Plate 1, p. 112)

DESIGNS:

Another useful exercise to which plasticine lends itself is the formation of various border, centre, and corner designs made up of geometric units, such as squares, circles, triangles, and other forms. Plate 5 and 6, pp. 116 and 117, show to a small extent what can be accomplished in this direction. The number of possible combinations is practically unlimited.

DRAWING ON PLASTICINE:

Plasticine may also be used to great advantage for simple drawing. Roll or press it out to form a thin slab. Ordinary school slates make excellent frames on which to roll out the material, as the sides serve to determine the depth of the plasticine and to facilitate the formation of a good flat surface. Use a blunt point as a tool for making the necessary lines, dots, or other markings. Plate 7, p. 118, shows a variety of patterns made in this way. The surface can be smoothed out when any alteration is required.

MODELLING IN CLAY

Success in modelling in clay depends largely upon the right consistency of the material. The pages of the Primer and the First Reader are full of suggestions as to suitable objects for modelling. These should be made use of as soon after the reading lesson as possible, while the ideas are fresh in the minds of the pupils.

The suggestions offered for modelling in plasticine may be largely followed in clay work, and vice versa. Suitable subjects, some of which the pupil will generally adopt when suggested by the teacher are:

ACTIVITIES OF THE HOME: Washing day, baking day, cleaning day, visiting, going to church, shopping.

THE FARM: Animals, implements, troughs, barns, sheds, fruits, vegetables.

FOODS: Milk, milkmaid's stool and pail, cows, butter making, cheese making.

TRANSPORTATION: Wagons, buggies, street cars, railway coaches, boats, ships, sleighs.

WATER SUPPLY: Wells, barrels, pumps, skin bottles, ancient water carriers, yokes, and pails.

SHELTER: Wigwams, snow houses, sand huts, log cabins.

VARIOUS INDUSTRIES: For example, the carpenter—his saws, hammers, chisels, saw-horses, planes, nails, tool chests.

GAMES: Marbles, skipping, baseball, football, cricket, etc.

INDIANS: Tepees, canoes, baskets, ornamental head-dresses, peace pipes, bows and arrows, and other articles illustrating the Indian life in peace and war.

In modelling various fruit and animal forms the children will require specific instruction with reference to the representation of certain features of the object. At this stage only objects of a fairly solid nature should be attempted. As examples of this specific instruction, take the following:

Apple: Take a piece of clay. Make a ball free from crevices, and a little smaller than the apple to be modelled. Notice the various lobes of the apple, and gradually add small pieces of clay well worked in until the desired shape is obtained. Next, by means of the finger and thumb, make, as far as possible, the recess in which the stalk grew. The deeper portion of this recess may be made with a piece of rattan. Hold the rattan between the thumb and finger and push it into the centre of the recess. Roll the rattan by sliding the thumb and finger one against the other, and at the same time give the whole hand a circular motion. Now take the opposite end of the apple. Make the recess there with the end and side of the thumb. Make a ball about the size of a very small pea and press it into the centre of the depression. With the rattan, make a hole in the centre of this flattened ball leaving only a ring formed by its edge. Roughen this with the point of the rattan and imitate the original as closely as possible. Insert a small roll of clay for the stem.

ILLUSTRATIVE LESSON

Every pupil has an apple, brought from home or supplied by the school. The apple is placed on the desk in front of each pupil.

Let us make a ball somewhat smaller than the apple. How can we do this? By rolling between the palms of the hands.

What else have we made in this way? Marbles. Make one. What is the difference between the marble and the apple? The apple is larger, but the marble is rounder and smoother. The apple has a little hole in the top and another at the bottom. What grew in these holes?

Are your apples all alike? Examine your apple. What do you notice? It has little hills or ridges. How can we make these ridges? By working in small pieces of clay. Do this until your apple is the right shape. Why did we make our ball a little smaller than the apple? So that we could add the little pieces and not have it too big.

Look at your apple again. What else do we want? The hole at the bottom. How can we make this? With the finger and thumb. Do this. Now look at the hole in the apple and the hole in your model. What is the difference? The hole in the apple is deeper. How can you make the hole in the clay apple deeper? By a little piece of round stick. Let the pupils try this, and correct if necessary.

Now take the other end and make the hole. Look at this hole in the apple. In the centre of this there is a little round piece sticking up. How can we make this? By pressing into our model a little round piece of clay. How large? As large as a small pea. Press this in and make it as much like the real apple as you can. (The teacher examines the work, and, where necessary, offers suggestions.)

Tell me any other things that can be made from a ball. Oranges, lemons, pears, plums, eggs, turnips, radishes, tomatoes, onions, grapes, cherries, strawberries, etc. Make some of these during your seat-work period.

Pear: Make a ball. Squeeze one side to the shape of the pear to be modelled. Finish as in the apple.

Orange: Form the general shape as above. To obtain the texture, take a small piece of round rattan or stick, cut the end square across and with this make the little depressions by tapping; or, twist a small piece of clay into the form of a thin stick, break off a bit leaving the end slightly rough and tap as with the rattan. A lemon may be modelled in the same way.

Acorn: Get the general shape from a small ball. The point may be obtained by pressure between the finger and thumb. Put the finger and thumb together and in the angle formed by their tips place the tapering end of the model. Now press the finger and thumb together and by turning the model slightly after each pressure, the sharp point so often found on acorns can be modelled. The opposite end of the nut is rough. Obtain this as in the orange, but with lighter and overlapping taps. The cup and its stem should be modelled separately.

Other round fruits, such as cherries, plums, peaches, may be treated in a similar manner.

Banana: Work up a good cylinder, smaller than the intended model. For the ridges, take a small roll of clay, the size depending on the size of the ridge; place it where the ridge is to be, and work it well into the cylinder.

Pods: (Peas or Beans) Make a cylinder and flatten it by pressure into a smaller shape than the desired model. For the mounds made by the peas and beans, take small balls, place them in position, and work well into the flattened cylinder. To form the seam at the back of the pod make two lines with a pointed tool; imitate the original.

Animal Shapes: These partake largely of the ovate form, and the attention of the pupils should be drawn to this. At this stage only bold, general shapes should be attempted. Select only familiar animals.

SAND TABLE

The sand table is a valuable adjunct in primary modelling. It is best to have, if possible, a table large enough for the whole class to work at, but a smaller one where three or four pupils can work at a time will serve, the others looking on and waiting their turn, or making various articles to be used in the general project.

In any class exercise every pupil should be given an opportunity to do some part of the work. In the building up of a project many materials may be used with advantage: toy animals to represent cows, sheep, hens, chickens, etc.; stones and pebbles for rocks; sticks and twigs for fences; water for brooks and ponds; small twigs and branches for trees; dolls, and toys. For many uses, the sand should be slightly dampened.

Preparation of materials for a sand table project will furnish work for some time. The project having been chosen, the separate units should be taken up and taught in detail, after which the pupils should be encouraged to suggest additions and variations. When articles are completed, they may be placed in the position thought best. As fresh objects are made, they should be added, the pupils being allowed to arrange and re-arrange as they desire. When materials sufficient to portray the whole scene have been accumulated, the final arrangement may be made.

If the project is a farmyard scene, various geographical facts are introduced as the landscape is worked up in relief. The fencing is then done, and the division made into roadways, wooded land, pasture, orchards, etc. The farmhouses, barns, pig-pens, chicken houses, stables, dog kennel, windmill, well, and pump should then be placed. As succeeding objects such as sheds, animals, farm implements are finished, additions are made to the scene until the whole is complete.

This project is typical. Many other subjects, taken from the Readers or the actual experience of the pupil, may be treated in the same manner. (Plate 8, p. 119)

PAPER CUTTING AND TEARING

First Step:

Let the pupils cut pictures from magazines, catalogues, newspapers, etc., in order to familiarize them with the use of scissors. The cut should begin near the joint and continue to within a short distance of the point of the scissors. A cut the entire length of the blade will leave a torn place or notch. Short, jerky cuts lead to unsatisfactory results. These pictures may be kept in an envelope and, if carefully selected, will be of use later in other studies.

Second Step:

Allow the pupils to cut representations of objects that particularly appeal to them; such as toys, furniture, tools, animals, landscapes. Young pupils cut more easily and readily than they draw, hence this work should precede drawing. (Plate 9, p. 120)

Third Step:

This step may take the form of cutting from silhouettes placed on the blackboard by the teacher in illustrating lessons in other school subjects. In these drawings, too much detail should not be attempted.

Fourth Step—Cutting from Memory:

1. The pupils are asked to close their eyes and picture to themselves the thing they desire to cut. When a clear mental picture is formed, the eyes are opened and the pupils proceed to cut.

2. Place an object before the pupils for a short time for close observation, remove the object, and require the shape to be cut as remembered.

3. Combine cutting from memory and cutting from objects, to make pictures illustrating various subjects, such as "Blowing bubbles," "Feeding the chickens," "Skating," "Skipping."

Fifth Step—Cutting from the Pose:

No branch of this work proves of greater interest to the pupil than the attempt to cut a picture representing a position taken up or an action being performed by one of his class mates. This method should be resorted to frequently.

Sixth Step:

Story work as explained in the three stages described in modelling in plasticine.

Tearing:

In some cases, irregular and soft edges are required. To represent such subjects as the horizon, clouds, trees in leaf, the paper should be torn rather than cut.

CUTTING BALANCED FORMS:

Symmetrical or balanced forms are obtained by folding the paper once. This axial line may be either vertical, as in a bell, a Christmas tree, a canoe, a heart, a vase, a bowl, a hat, or in the letters A, M, T, V; or horizontal, as in the letters B, C, D, E. The shapes of many common leaves may be cut in this way.

Some objects will require both a vertical and a horizontal fold. This will be the case in cutting a picture-frame, a rolling-pin, a calendar mount, a star, and certain letters of the alphabet, as H, O, X.

MOUNTING:

When the pupil has had practice in grouping his cuttings, let him mount them on a back-ground of suitable colour. Good results can be obtained from the use of the softer or dull shades of common brown or gray wrapping paper for these mounts.

CLASS SCRAP-BOOKS:

Each grade should have a class scrap-book. In the Primary classes this would form a sort of supplementary reader or reference book, consisting largely of pictures relating to various phases of the school work. In all cases, before anything is pasted in the scrap-book it should be submitted to the teacher.

In addition to the class scrap-book each pupil should be encouraged to keep one of his own. The teacher should seek to influence the pupils as far as possible in their choice of pictures and subjects.

PAPER FOLDING

Paper folding is really a kind of drawing, the lines being formed by creases in the paper instead of by a pencil. Some of these creased patterns form drawings from which a large number of articles may be constructed.

As paper folding is sometimes done from direction the pupils should all place their papers in similar positions. Arrange the papers on the desk with one edge parallel to the front. In this position elicit the names of the edges and corners, as upper edge, right-hand upper corner, left-hand lower corner, etc.

Fold the paper with both hands and in all directions. Check the habit of always folding with the same hand and in the same direction. Let each fold represent something to the pupils; they are making things, not folding papers. Thus, papers in position; fold right edge over to the left edge; crease. What is this? A book or a screen. Read something from memory from your little book.

What is a screen used for? Imagine something behind the screen.

To the pupil, this fold may also represent a mat, the edges being cut to form a fringe; or it may represent a chicken coop, toothpicks, pea-sticks, or strips of paper being used to represent slats. Other simple objects such as shawls, sails, tables, toboggans, parasols, etc., may be represented by various folds.

The common geometrical figures may all be made by folding the square. (Plates 10 and 11, pp. 121 and 122) Many new terms will be employed—diameter, diagonal, angle, etc. Constant repetition of these will fix their meanings.

OBJECTS BASED ON THE SQUARE: (Plate 12, p. 123)

Fold into sixteen squares. This is commonly called the "checker-board."

Illustrative Lesson

The "checker-board" is the foundation form from which many objects may be made. The teacher will do well to devote considerable attention to his method of development. The following is suggestive:

Distribute squares with 8-inch sides; let the pupils observe the number and length of the sides. Opposite sides are equal. All four sides are equal. Compare the corners. They are all equal. This figure is a square. Write the name on the board.

How may the square be divided into two equal parts? By folding. Fold the bottom edge of the square so that it lies exactly along the top edge. Crease. Move your finger along these edges. What do you find? One lies exactly upon the other. We may call that a double edge. What shall we call the edge underneath? The lower edge. What shall we call the edge which covers the lower edge. The upper edge. What has happened to the left edge? One half of it has been folded on the other half. Open out the square and observe the crease. What does it look like? A straight line. Where does it lie? Between the middle points of the right and left edges. How does it divide the square? Into two equal parts. What part of the square is each part? One half.

What else has the crease divided exactly? The left and right edges of the paper. What is the length of each half side? Four inches. Set down on your paper, "One half of 8 is 4."

What is the length of the crease? Eight inches. Fold the bottom edge to the crease and the top edge to the crease. Into how many parts is the square now divided? Four. What is the length of each long side? Eight inches. What is the length of each short side? Two inches.

Without turning the paper, fold the right-hand edge over to the left-hand edge. Into how many parts is the square now divided? Eight. What is the length of the long side of one of these eight parts. Four inches. What is the length of the short side? Two inches.

Fold the right and left edges to the crease just made. Into how many parts is the square now divided? Sixteen. Number them with your pencil. Take one of the sixteen parts and tell the length of each side. Two inches.

Compare the square corners. They are all alike. What can you call each one of these sixteen figures? A square. How many of these make up the big square? Sixteen. How many make up half of it? Eight. How many make up a quarter of it? Four.

From this checker-board we will some other day make boxes, wall pockets, barns, fireplaces, tents, chairs, and tables.

The teacher need hardly be reminded that in this exercise the pupils have been learning incidentally, but in a concrete and practical way, the relations of the numbers 2, 4, 8, and 16.

Box:

Cut along lines indicated in Fig. 1, Plate 12, p. 123. Fold and paste.

The teacher should place a drawing of the folds on the black-board, showing very clearly the lines to be cut.

Turned upside down, this will represent a table. The pupils will suggest cutting out a portion of the sides to form legs; or separate legs may be pasted on. A somewhat larger square pasted on the top is an improvement.

Add wheels and two strips of paper to the box to form shafts, and a cart is made. This method should be adopted wherever possible and the pupils always encouraged to suggest modifications and improvements.

Wall Pocket:

Fold the checker-board. Cut out two upper corner squares and make other cuts as shown in the diagram. Fold and fasten (paste or paper fasteners).

This may be an oblong box with lid, or a cupboard with door; two pasted together back to back form a knife-box. (Fig. 3, plate 12)

Barn:

Fold checker-board. Cut as shown. Paste the two inner squares on each side over each other and thus form the roof. Bring the corner squares at each side inwards and paste, taking care to have their lower edges in the same straight line. Fold the doors back. (Fig. 5, plate 12)

Fireplace:

Fold the checker-board. Cut on lines as shown. Fold squares 1 and 3 over 2, and paste. Fold back the opening for the fire. (Fig. 6, plate 12)

Oblong Box:

Fold the checker-board. Cut off one row of squares, thus leaving twelve squares. (The strip cut off may be used for additions required to complete the various articles, as wheels and shafts, backs for sofa, couches, wash-stands, bureaus, and cupboards.)

Cut on the lines as shown. Fold and paste. This will form an oblong box, turned upside down a stool. Legs may be cut out as in the case of the table. Folding square 1 over 3, and rolling square 2 over on the top, makes a couch.

Other articles that can be made from this fold are: couch, basket with sloping sides, bodies of wash-stands, bureaus, sofas, cradles, cupboards, beds, carts, wagons, street-cars, coaches, bookshelves. (Fig. 2, plate 12)

Cubical Box:

Fold the checker-board. Cut off a strip of four squares and then one strip of three squares, thus leaving nine squares. Cut along the lines shown. Fold and paste. This fold may be used to make a cubical box, or, by folding square 2 upward, a chair is formed. (Fig. 4, plate 12)

Other objects are shown on plates 12 and 13.

WEAVING

Weaving is one of the oldest industries and one of the first occupations of all primitive peoples. The materials are paper, raffia, wool, yarn, string, etc.

For the first lesson, provide the pupils with paper looms and weavers. After they have used these once or twice in making various patterns they will be anxious to make looms for themselves. The weavers, which should be of a colour

to harmonize with the mat, should be first woven in, under one and over one. From this the pupils may be easily led to see how the various designs are developed by weaving under one, over two, under two, over two, etc. To finish the mats, trim the projecting ends and fasten each strip in place by pasting along the margin on the wrong side. An infinite number of patterns may be made in this way. The pupils may be shown that the most intricate carpet patterns are founded on this principle. (Plate 14, p. 125)

After the mats are woven they may be made into various articles, such as picture mounts, book covers, napkin-rings, book marks, tidies, match holders, hat pin holders, small boxes, or other similar articles. (Plate 15, p. 126)

A Paper Loom:

Provide the pupils with, or have them cut, an 8-inch square of stiff paper. Measure one inch from each angle along each side. Connect opposite points. This will give a 6-inch inner square. Set off half-inch spaces along two of the opposite sides of this. Join the points. Cut along these lines with a sharp knife or fold the square along one diameter and cut with the scissors.

For weavers, cut twelve strips of a blending colour one half-inch wide and seven inches long.

The use of different-coloured strips and mats affords an opportunity to teach a certain amount of colour harmony. Begin by using the standard colours with their tints and shades, or with neutrals. Later, lead the pupils to the use of more pleasing combinations.

WORK IN RAFFIA

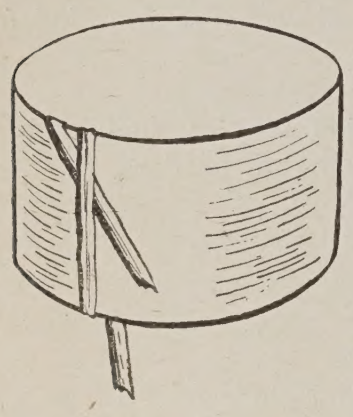
This material can be used either alone, as in mats, woven or knotted bags, soft-coil baskets, hats, cushions, braids; or in combination with other materials, for example, with cardboard foundations as in napkin-rings, mats, boxes, pin-cushions, photograph frames, whisk holders, penwipers, etc., or with rattan for Indian basket work.

The material requires very little preparation. It is imported in bales made up of large plaits or braids. When these are unbraided, and before they are divided into individual strands, wash out the dust by moving them about in water. Raffia should always be used in a moistened condition. If only a small amount is required, run the strand of raffia through the finger and thumb in a bowl of water. For larger quantities, soak for a short time in water. To secure good, even work, select strands of an even width. The pupils should learn to distinguish the root end, which is simply that portion of the cuticle from the base of the leaf. When raffia is to be pulled through close material as in sewing and some forms of basketry, the root end must be inserted first or the raffia will ravel.

Wool, soft cord, carpet ravellings, strips of clean rags, yarn, dried grasses, may all be utilized for this work.

WINDING OR WRAPPING:

This is one of the simplest methods of using these materials. It consists of covering some foundation (usually cardboard, splint, or rattan) by means of wrapping.



A napkin-ring makes a good first model. Take a strip of cardboard of the desired width and long enough to give two layers when coiled to the required diameter. These may be fastened so as to keep this shape. Moisten a piece of raffia and commence wrapping with the root end. If the end be overlapped as shown in the sketch, it will hold securely. Employ the same method when new strands are required. (Plate 16, p. 127)

To finish the wrapping, thread the last strand (using a No. 18 or 19 rug or tapestry needle), and pass it under several layers, and cut off the waste material.

MATS

Mats can be made of various shapes by wrapping on a cardboard foundation. Cut a hole of the desired diameter in the centre of the shaped foundation. Cover with raffia or other material by passing the strands through the centre hole and over the outer edge. These can be used for various purposes, as mats for ink-wells, flower vases, ornaments, etc. Frames for pictures and photographs may also be treated in the same manner. (Plate 16, p. 127)

After braiding has been taught, borders or simple patterns may be added. The edges may be finished by overcasting, hemming, blanket or button-hole stitch.

Mats and rings may be combined to form boxes and trays. A small mat with a peg through the centre will make a top. A small stick added to a shaped mat makes a fan. Two mats with a few layers of flannel between form a penwiper or needle-book. Oblong pieces of cardboard wrapped may be used for book covers, needle-cases, etc. The hinge may be formed by the herring-bone stitch. A number of round mats partially overlapping each other form a post-card holder.

BRAIDING

Many different weaves are used in braiding, but for school purposes the two described will be found sufficient. In the following analysis "right over" means that the strand held in the right hand is to be passed over the next strand as in darning. This is intended to be repeated by the pupil as the braiding proceeds until repetition is unnecessary. (Plates 17-18, pp. 128-9)

ANALYSIS:

When an odd number of strands is to be braided:

For 3 strands: Right over,
Left over.

For 5 strands: Right over and under,
Left over and under.

For 7 strands: Right over and under and over,
Left over and under and over.

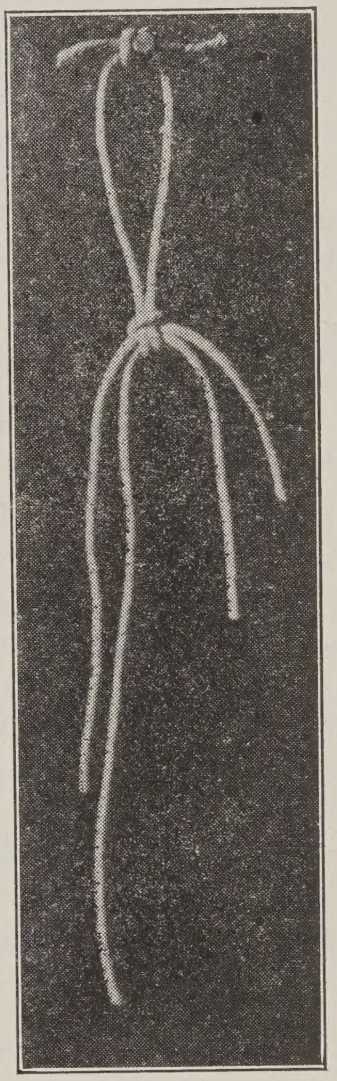
It will be noticed that the weaving by both hands is similar.

When an even number of strands is to be braided:

For 4 strands: Right over,
Left under and over.
For 6 strands: Right over and under,
Left under and over and under.
For 8 strands: Right over and under and over,
Left under and over and under and over.

Notice that in braiding with an even number of strands if one hand begins the weaving by passing the strand *over,* the other hand will begin its share of the weaving by passing its first strand *under.*

When dealing with a large number of strands, the braiding may be done by taking the left-hand strand and weaving under and over towards the right in the usual way.



HOW TO COMMENCE

Avoid the ugly knot so often used. Tie as shown in the illustration. Have the strands of different lengths so that the introduction of new strands will not mar the evenness of the braid. Tie the work to any convenient object to hold it taut. To join, place the new strand alongside the other and braid with the two strands as if they were one. After braiding for a short distance the waste end of the old strand may be cut off close to the braid. No knots are used. Raffia of different colours may be used in the same braid. Useful table mats may be made by sewing the braids edge to edge.

In making small hats or bonnets, begin at the centre of the crown and stitch the braid edge to edge. Moisten the braid and hold it in the desired position when the sewing is being done.

Wide braids may be used for belts and narrow ones for cords for various purposes.

Flat surfaces of all kinds may be made by stitching the braids edge to edge. These may then be made into many objects, such as needle-cases, handkerchief cases, small bags, book covers, etc. (Plate 19, p. 130)

SIMPLE LOOMS

Four sticks tied together in the form of an Oxford frame make a good simple loom upon which good work can be done. The frame of a broken slate makes a useful loom.

Cardboard looms of many shapes may be made by notching the board on opposite edges to hold the warp strands. A bead loom made from a cigar box serves for the weaving of belts, ties, or other narrow articles. (Plate 20, p. 131)

HOW TO PLAN SIMPLE WEAVES

A Plain Weave. This is made by using one colour only for the warp and one colour for the weft, the alternate warp strands being raised and lowered alternately, as in simple darning.

Stripes across the goods. Use a plain warp and weft of the colours desired for the stripes which will be changed at regular intervals according to the width of stripe required.

Stripes running lengthwise of the goods. In this case reverse the order for the previous pattern. When stringing the warp strands, arrange them in the form of the stripes required and use only a plain weft.

Checks. The warp is arranged in dark and light stripes and the weft is woven across in the same order as occurs in the warp.

Plaids. Use a striped warp and various coloured weft changed at regular intervals. Various other patterns may be made in a manner similar to that in paper mat weaving, by passing the weft under or over a number of warp strands at the same time, to give the necessary length of colour required in that particular part of the pattern.

The teacher may design patterns for weaving on paper ruled in small squares.

It should be understood that any suitable and available material such as wool, clean rags, soft twine, silkoline, hemp, jute, rushes, may be used for weaving.

RAFFIA AND CANVAS

Use coarse canvas for little children. This forms a useful introduction to sewing, as many of the stitches may easily be taught on this material, for example, all the edge or border stitches like overcasting, blanket, button-hole, herring-bone, feather-stitch. As the canvas is large in the mesh the number of spaces may readily be counted and the stitches, which should be large, kept regular in size as well as in spacing.

Running, back-stitching, cross stitching, diagonal stitching, may be used for decorations or pattern effects. Needle-books, glove cases, blotters, handkerchief cases, bags, and many other useful and artistic objects may be made. (Plate 21, p. 132)

FORM II

PLASTICINE AND CLAY MODELLING

Continue the free modelling in plasticine as outlined for Form I. An almost unlimited choice is afforded by the work in geography, history, nature study, and Bible stories.

In geography, the lessons on various land and water formations, plants, and child life in other lands, suggest topics for modelling. Imaginary travels will provide material illustrative of the various modes of transportation. The clothing worn by the various peoples mentioned in the stories calls to mind the animals or plants from which its materials are made.

History stories, in a similar manner, will offer opportunities for the modelling of forts, guns, shields, ancient and modern weapons of warfare, national costumes, the implements used by pioneers, and representations of their various pursuits and dwellings.

In nature study insects, birds, animals, vegetables, and trees may be represented. The germination of peas and beans and the various ways in which leaves grow from the parent stem may be well illustrated by modelling in plasticine. (Plate 1, page 112)

Wherever possible good models or pictures should be provided so that the pupils may study them to get clear ideas regarding general form. The teacher should call attention to the characteristics of the various parts so that the pupils may study them more closely. (Plates 22, 23, 24, pp. 133, 134, and 135)

GENERAL DIRECTIONS FOR MODELLING

1. Build up by adding small pieces of clay well pressed together to a size rather smaller than the intended model, but having the same bold general character.
2. Go over it again, adding a little here and taking a little away there, and so get more detail. Continue this until the desired result is obtained.
3. The *position* of the clay model should always correspond to that of the original when comparisons and observations are made.
4. Study the outline of the model from *all* directions.

To Make a Slab:

Take small pieces of clay and press them well together, so that no holes remain in the mass. Make the slab about half an inch thick.

Smooth the top with the side of the thumb, stroking first in one direction and then in the other.

Now turn the slab over, smooth the second side in the same way, and fill in any holes with additional clay.

Trim the edges to get the desired size and shape.

Smooth the surface with a moist thumb or finger.

Later, when the slab is simply a foundation for a model, quicker methods can be adopted:

(*a*) It may be rolled out as in rolling out dough for a pie.

(*b*) Two strips of wood, say 3/8 in. thick, may be placed on the modelling board, at the requisite distance apart, and the space between filled by pressing

in small pieces of clay till the surface is slightly higher than the slats. Take a thin piece of wood or other scraper long enough to stretch across both slats and, with light and frequent strokes, scrape the surface of the clay until it is level. Remove the slats and trim the edges not formed by the slats. The scraper should be sloped in the direction in which it is to be drawn.

These mechanical methods should not be used until the pupils have acquired a fair facility in modelling slabs. These are quick methods and are used to save time so that more attention can be devoted to the modelling of the object which is to rest on the slab.

TILES: (Plate 24, p. 136)

The slabs previously referred to may be formed into tiles which offer opportunities for design, either incised or in low relief. These when fired, make serviceable stands for tea-pots, flower-pots, etc. In the case of young pupils the patterns may be obtained by folding and cutting paper.

After the slab is made apply the paper pattern, and take out, to an even depth, all the clay not covered by it. Leave a margin round the edge of the tile. Geometrical patterns may be obtained in this way, and the pupils may also learn the use of the "templet" or pattern, so common in the regular workshop.

At a later stage, patterns based on plant and flower formations may be used to great advantage; but in designing, always bear in mind the use to which the object is to be put. If the tiles are to be used for tea-pot or other stands, the surface must be left comparatively flat so that the object will rest firmly; but if the tiles are for decorative purposes only, the designs may be made in any degree of relief.

A CIRCULAR DISH:

Make a ball by pressing small pieces of clay well together and by rotating in the palms of the hands. Now flatten the ball on the board to make a thick disc, press a hole in its centre by means of the thumbs, taking care not to press too deeply. In this manner spread out the sides of the disc to the required size (height and thickness of sides, and diameter of dish). Keep the sides and base about three eighths of an inch thick.

Press the extreme edge of the disc between the finger and thumb and reduce it to about one eighth of an inch in thickness. Smooth with a moist finger.

AN OBLONG OR SQUARE TROUGH:

Make, of a fairly firm clay, a base of the required size and about half an inch thick. Build up the sides in the usual manner with rather softer clay well kneaded. Smooth with a moist finger.

PAPER FOLDING AND CUTTING

FREE CUTTING:

Continue the work in free cutting as outlined for Form I. Give greater attention to the arrangement of the various parts of the story. The figures should now be cut with that greater care which results from closer observation of characteristic features. The stories at this stage may be suggested by games, occupa-

tions, special seasons and days, imaginary travels (land and water forms), and simple historical facts. Many other suggestions for carrying on the work along these lines may be obtained from the Course of Study in geography, history, and nature study for this Form.

The "centres of interest" such as the farm, foods, transportation, etc., recommended for clay modelling in Form I may be used with advantage in this connection.

The following sequence of foldings will give various geometrical units which are of service in the formation of patterns and designs originated by the children themselves. If the children work from different-coloured sheets, they may exchange their units and thus secure various colours for this pattern building.

1. *The Square*:

The checker-board is folded as in Form I and the small squares are cut out. These units can be arranged in many ways. (See Plate 26, p. 137)

2. *The Oblong*:

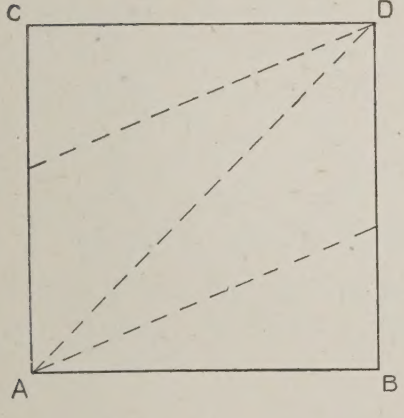
These may be arranged as in No. 1 or combined with the square. Many other combinations may be seen in oil-cloths and linoleums.

3. *The Right-angled Triangle*:

See common linoleum patterns for many other arrangements, especially when different colours are used.

The methods of folding the above are given in Form I.

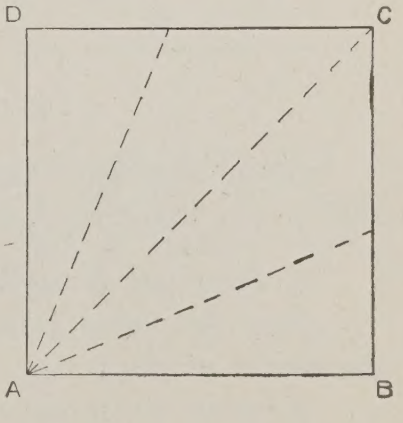
4. *The Rhomboid*:



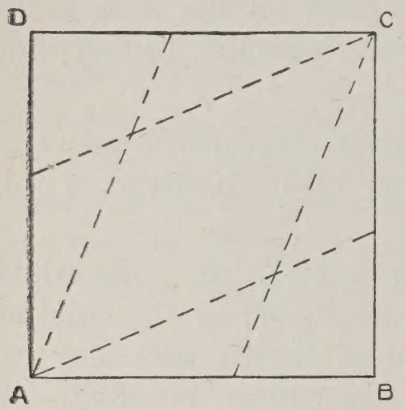
Fold on the diagonal AD. Fold edge AB on the diagonal AD. Fold edge CD on the diagonal.

5. *The Trapezium*:

Fold for the diagonal AC. Unfold. Fold lower edge AB along the diagonal AC. Fold edge DA along the diagonal AC. This unit is well adapted for the formation of stars of various shapes.



6. *The Rhombus* (Diamond):



Fold edges AD and AB on the diagonal. Unfold. Fold edges CD and CB on this diagonal. The creases on the reverse side show the folds for the required figure.

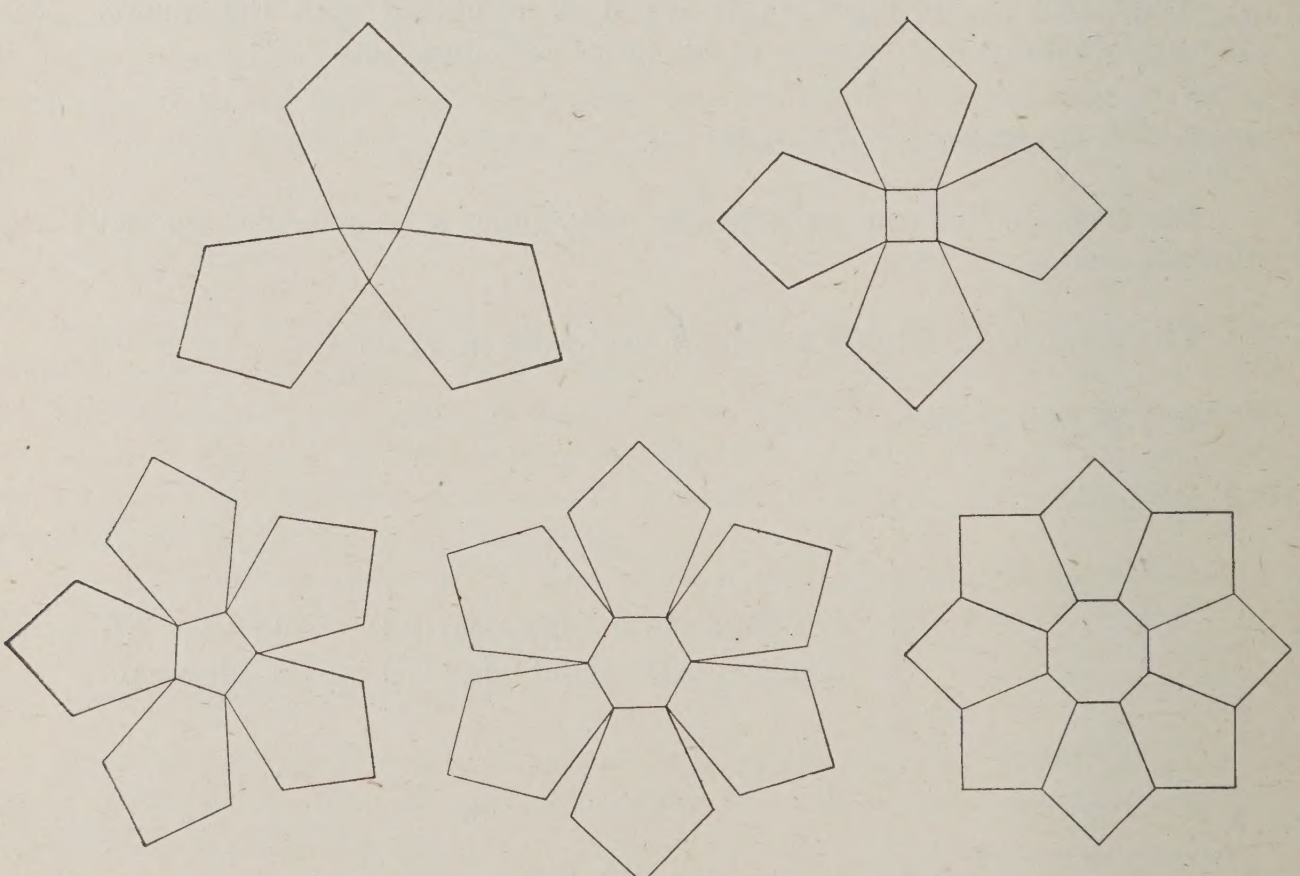
With this shape as a unit build various border patterns as previously described.

7. *Irregular Pentagon*:

Fold one of the acute angles of the trapezium or diamond inwards to the centre of the figure.

Using this as a unit, stars having from three to eight points may be built round any regular figure, up to the octagon, having sides equal to the smallest side of the pentagon.

An equilateral triangle gives a three pointed star, a square gives a four pointed star, a pentagon gives a five pointed star, and so on.



(This unit is derived from the trapezium.)

Other star formations may be made by building any number up to eight in such a way that their acute angles meet at a central point.

8. *Irregular Hexagon*:

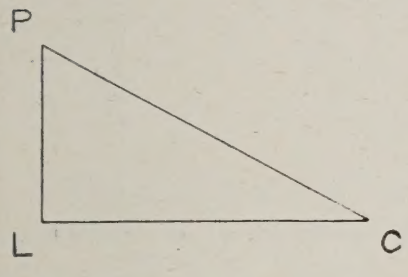
Fold the acute angle of the irregular pentagon formed from the diamond to the centre of the figure.

Arrange six hexagons around one hexagon. Arrange eight hexagons around an octagon.

TO FOLD REGULAR GEOMETRICAL SHAPES FROM THE SQUARE, AND FROM THESE, WHEN FOLDED, TO CUT STARS AND LEAF FORMS

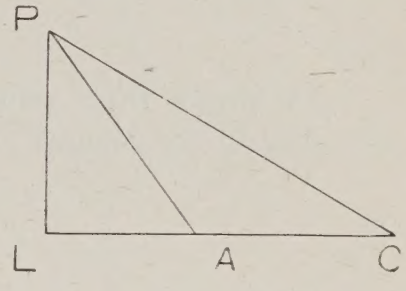
GENERAL RULE:

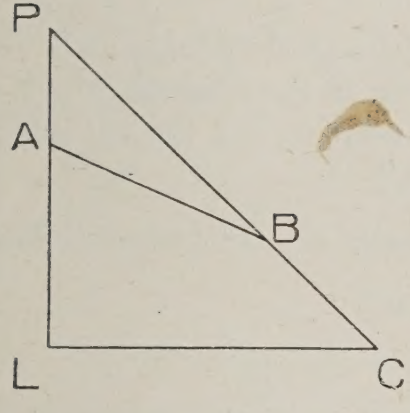
When these geometrical forms have been cut, they should be folded in such a manner that all the *angles* of the original figure, however many sides it contains, are at one angle of a right-angled triangle. From this all stars and leaf forms are cut.



P contains all the angles of the original figure.
C is the centre of the original figure.
These two facts must be constantly kept in mind.
L is the angle cut away in making leaf forms.

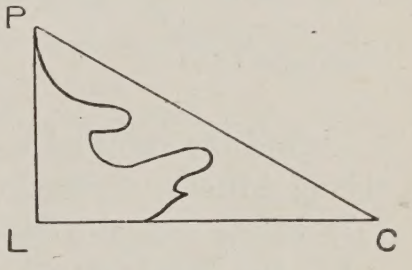
If PLC were a folded pentagon and a cut were made through all the folds of the paper along the line PA a five pointed star would be the result.





If PLC were a folded square and a cut were made along the line AB the result would be a Maltese cross.

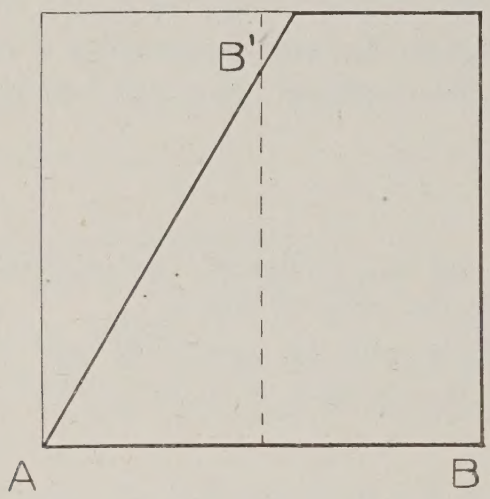
If PLC were a folded hexagon and a cut were made along the line shown in the design the result would be a six pointed leaf form.

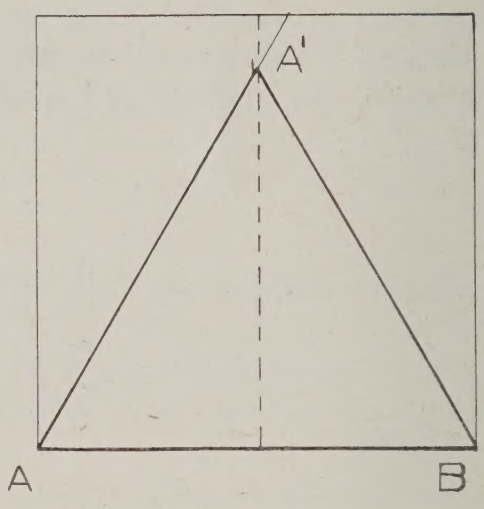


In all geometrical cutting of folded forms the outline of the paper, after the cut has been made, should be one half of one of the units of which the desired figure is composed, for example, the shamrock is composed of three units (or leaves) and the cut will give one half of one of these units.

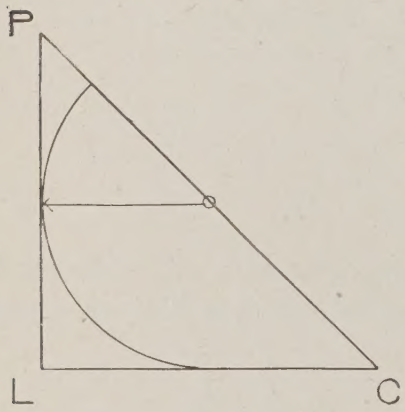
Equilateral Triangle:

Fold a vertical diameter. Unfold. Fold the edge AB so that the point B falls on this diameter. Cut off the part to the left of AB. Unfold and refold on the vertical diameter. Cut off the part to the right of this.





To obtain three pointed stars or three pointed leaf forms, fold and cut as described in the general rule.



Quatrefoil:

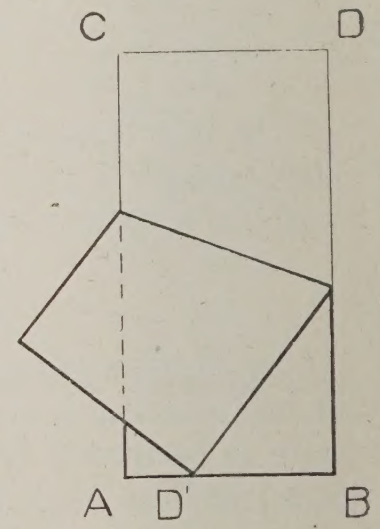
Fold a square to a right-angled triangle as in the general rule. A cut as shown in the diagram will give the figure required. Be careful to end the cut where the curve touches the side CL.

All four pointed leaf forms are cut from this fold.

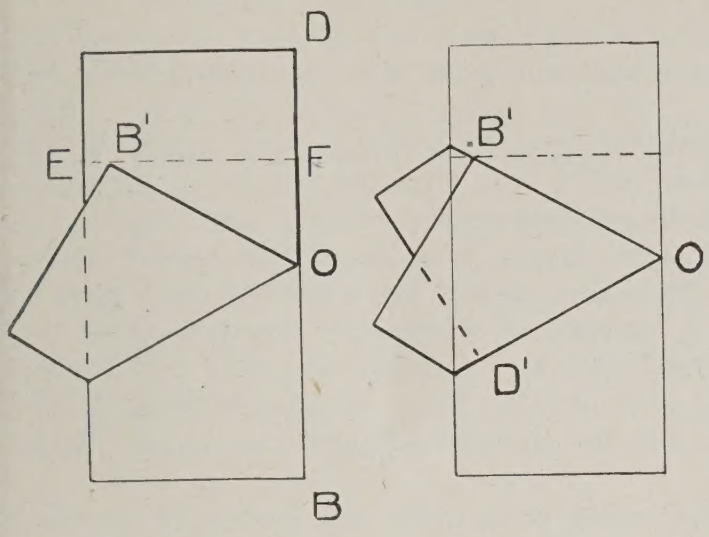
Pentagon:

Fold the right edge over to the left edge, forming an oblong ABDC. Trisect AB. Fold the upper right corner (D) to the second division from B. From the point D, cut to the upper left corner.

For five pointed stars and leaf forms, fold and cut according to the general rule.



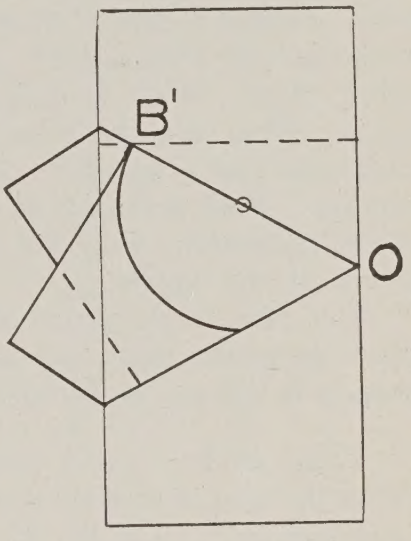
Hexagon:

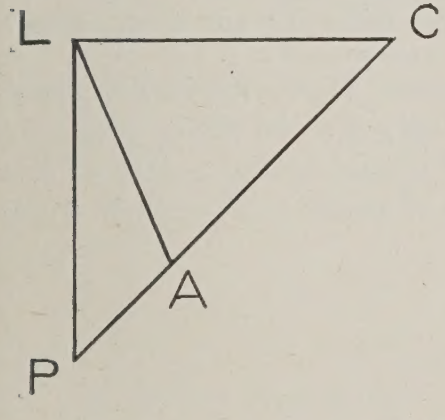


Fold the right edge over to the left edge. Divide the folded edge into four equal parts. Fold the upper quarter, thus giving the crease EF. Unfold. Fold the edge OB (that is half the folded edge BD) so that B falls near the end of the line EF. Fold back the upper portion along the edge OB.

Cut from the point B to the corresponding point D through all the folds of the paper.

The trefoil is also cut from this fold. On BO describe a part of a semicircle, finishing the curve as shown. Cut, through all thicknesses of paper, along this line.





Octagon:

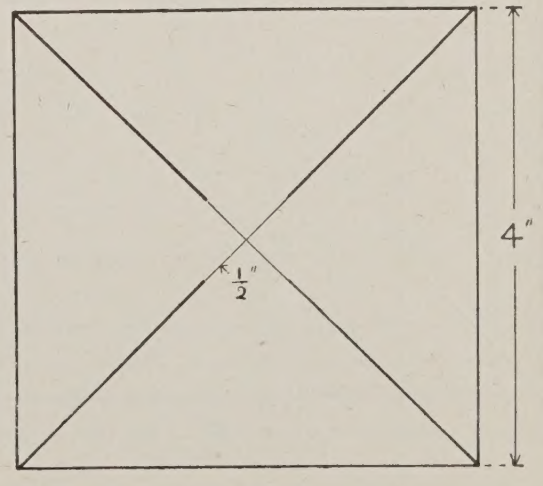
Fold the upper right corner to the lower left corner. Fold the lower right corner to the upper left corner. Fold the upper corner to the lower corner. Make CA equal to CL and cut from L to A.

OBJECTS MADE FROM PAPER

The following objects are to be made from heavy paper. Lines which were previously obtained by folding are now to be obtained by drawing. Work in this material forms an introduction to the series of cardboard models which follows:

1. *Windmill*:

With ruler and set-square (any object having one right angle such as a machine-cut envelope or visiting card may be used) construct a square having 4 in. sides. Draw diagonals, and measure half an inch from the centre along each diagonal. Cut out the square. Cut along the diagonals to the half-inch mark. Roll the right-hand corner over and upwards. Insert a pin through the ends of the wings and the centre of the square. Fasten to a stick.



Development of a Lesson on a Windmill

Show the completed model. What are windmills used for? Flatten the model out. What shape is it? Square. What must a square consist of? Four equal sides and four equal angles.

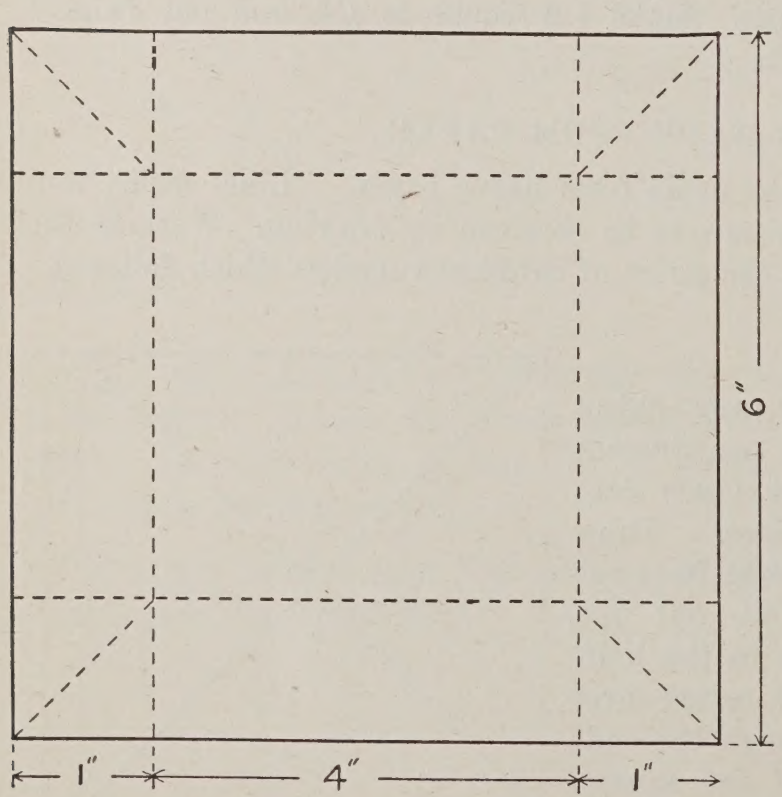
Where does the builder start in building a house? At the bottom. What is this called? The foundation. Draw a line four inches long near the bottom of the paper. Why four inches? Because the model is four inches square. Would any other length do as well? Yes. If we drew the base line six inches, what would that mean? Every other line would have to be six inches. From each end of this base line draw lines at right angles by the use of a visiting card, envelope, or set-square. Compare these two angles. They are equal. Make each of these lines four inches long. Why four inches? Because the base is four inches. Join the ends of these lines. What will be the length of this line? Test with the ruler. What is the completed figure? A square. What is a square?

Join two opposite corners. Into how many parts does this divide the square? Two. Compare them. They are equal in size. How can you test this? By folding. What is each part called? A triangle. Join the other two corners. How many parts now? Four. What is each shape called? A triangle. Compare sizes. They are all equal. What are the lines joining opposite corners called? Diagonals. How many diagonals has a square? Two. Why only two? Because the figure has only four corners. What are each of these corners called? Right angles. Compare the lengths of the diagonals. They are equal. What is the point where the diagonals cross? The centre of the square.

Cut from each corner along each diagonal to within half an inch of the centre. (Let the pupils finish the model from their observation of the specimen.) What will happen if the pin is fastened too tightly to the stick? The mill will not turn. Why?

The models made may all be tested during recess. Have windmills made twice the size, and half the size. A triangular basket may also be made with this construction. Fold the diagonals and cut along one diagonal to the centre of the square. Fold into shape. Make a handle with a strip of paper half an inch wide.

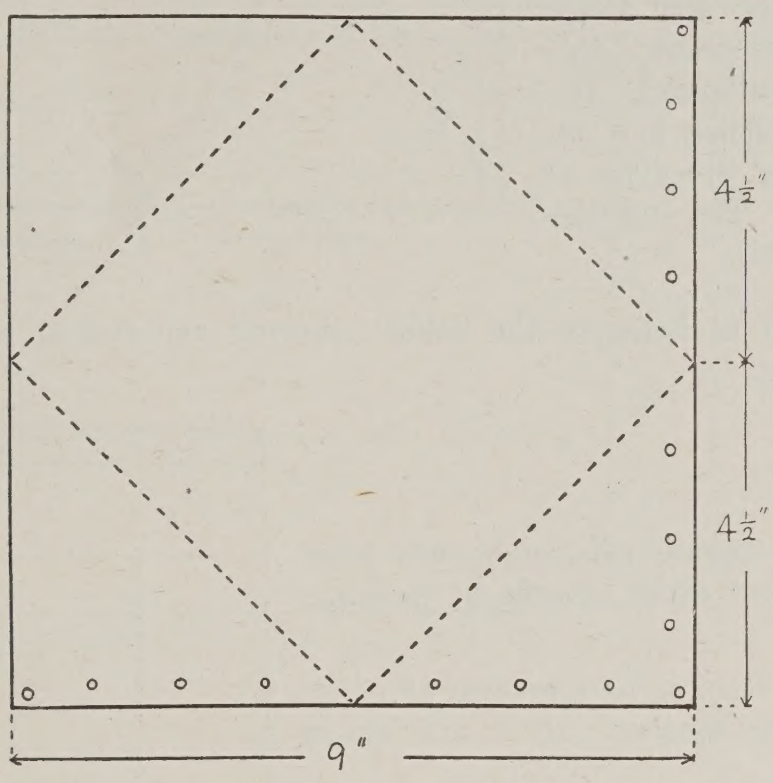
2. *Paper Box*:



Take a square of any size. Measure one inch from each angle along each side. Join opposite points. From the angles of the original square draw the diagonals of the four corner squares. Fold along the dotted lines, pinch corners together, and tie or lace. (See p. 47)

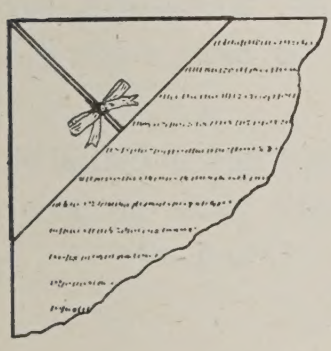
3. *Handkerchief Case*:

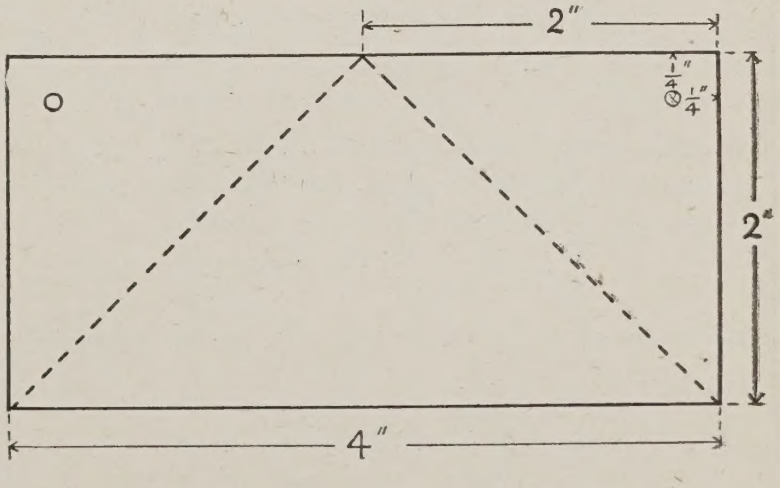
From stout paper or very thin cardboard cut a square having sides nine inches long. Find the centre of each side and join points on adjacent sides. Punch holes. Fold triangles to the centre of the square. Lace or tie. (See p. 47)



4. *Corner Bookmark*:

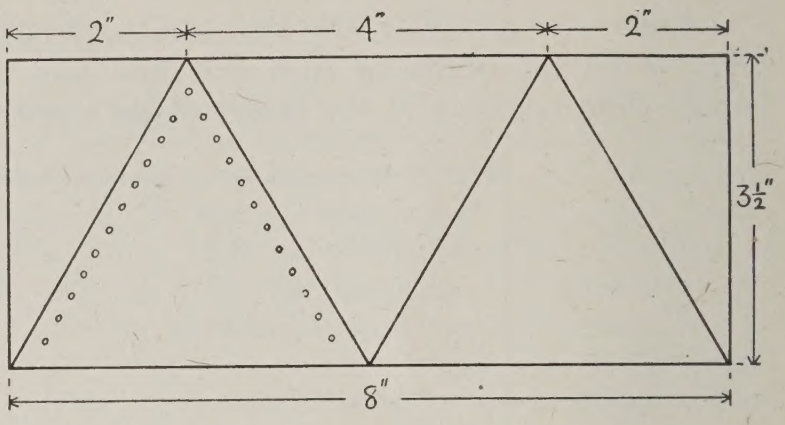
Make a rectangle 2 in. by 4 in. Find the centre of one of the long sides. Fold as shown in the diagram. Punch holes and tie.





5. *Twine Holder*:

Construct a rectangle eight inches by three and a half. Divide the upper longer edge as shown. Obtain the middle point of the lower edge. Join these points. Cut into three equilateral triangles. Punch holes half an inch apart along two sides of each triangle. Tie together as shown on p. 47.



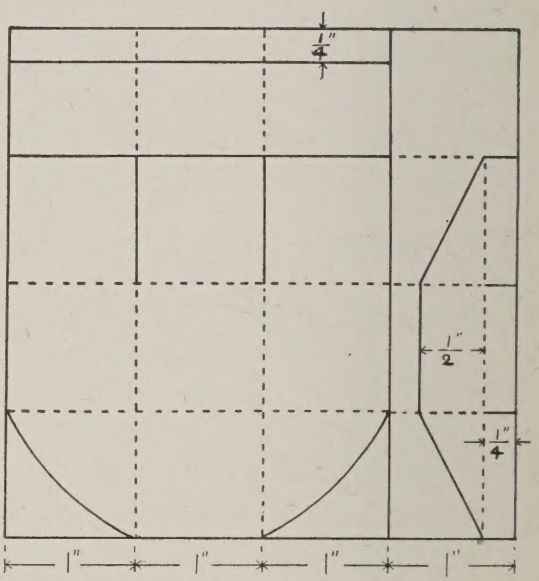
Place a ball of twine in the holder allowing one end of the twine to pass through its point.

6. *Coal Box*:

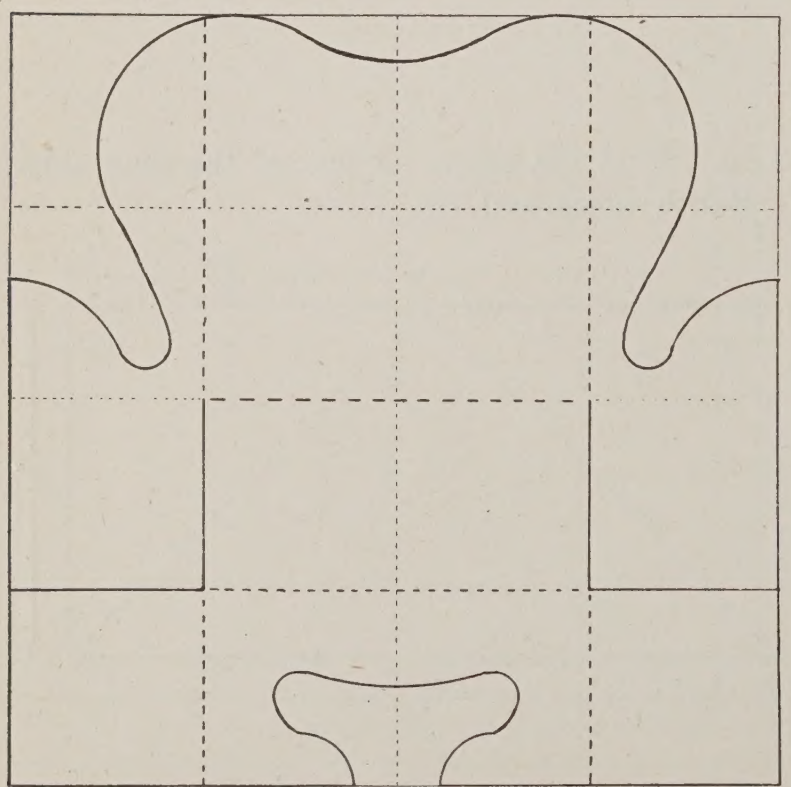
Construct a square with eight-inch sides. Divide into sixteen equal squares by measurement.

Cut off one strip of four squares and then one strip of three squares. Draw and cut as shown.

From the strips cut off, draw, and cut the base and the handle. Fold and paste. (See p. 47)



7. *Settle*:

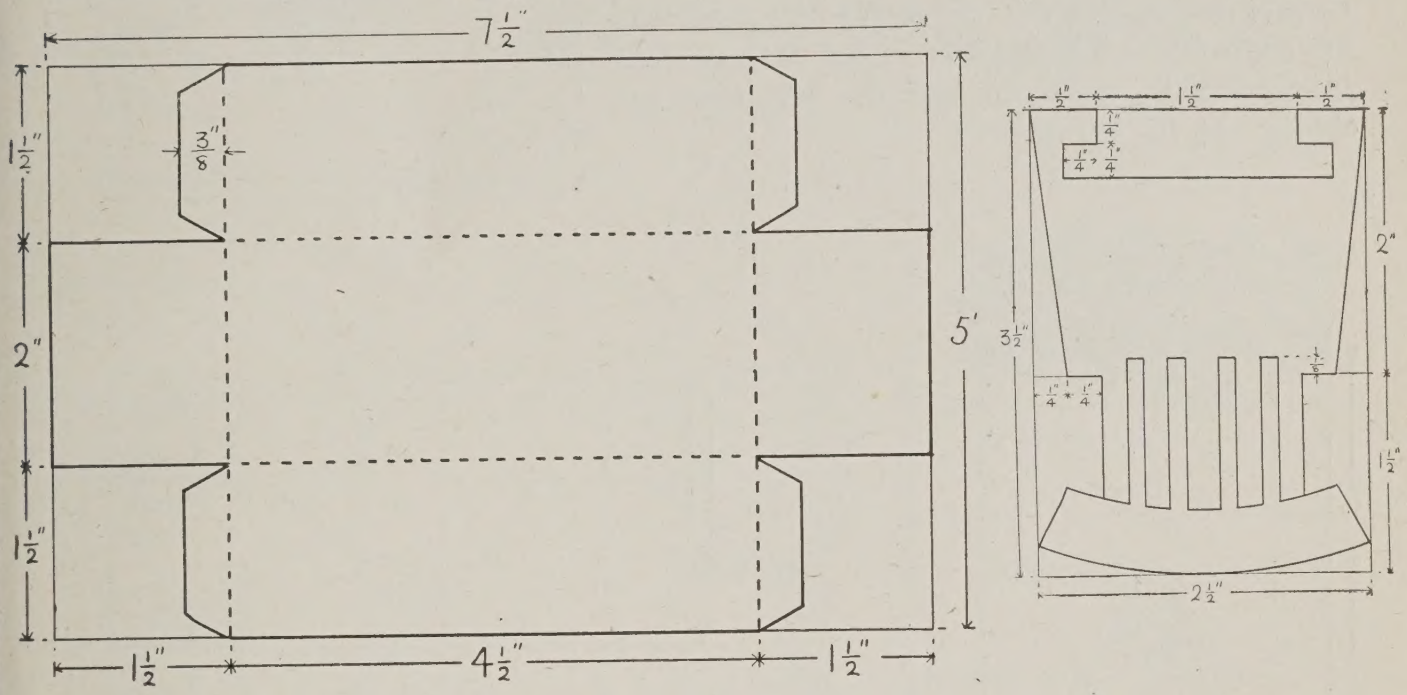


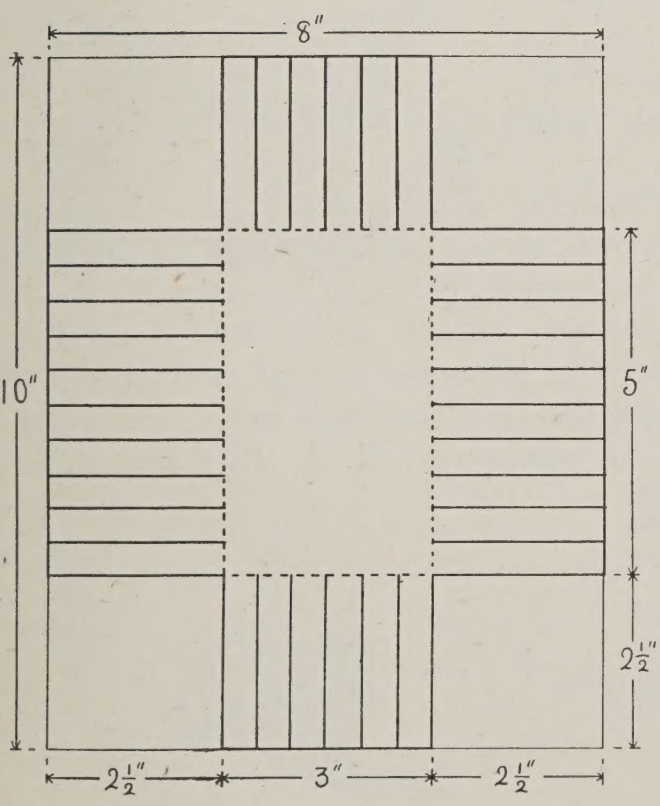
Construct a square of any size. Divide as before into sixteen squares. Any design may be drawn for back, arms, and front.

Cut and fold as indicated. Fasten with paste or paper fasteners. (See p. 47)

8. *Cradle*:

For the body of the cradle, construct an oblong 5 in. x 7½ in. Draw as shown in the plan. Cut, fold, and paste to form an open oblong box. For the ends, cut two pieces as shown, or according to fancy. Paste the ends to the body of the cradle as shown on page 47.



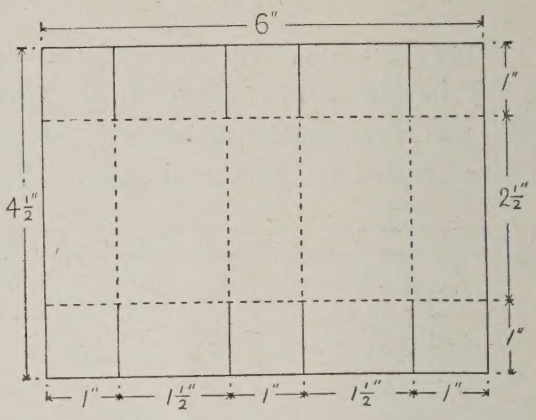


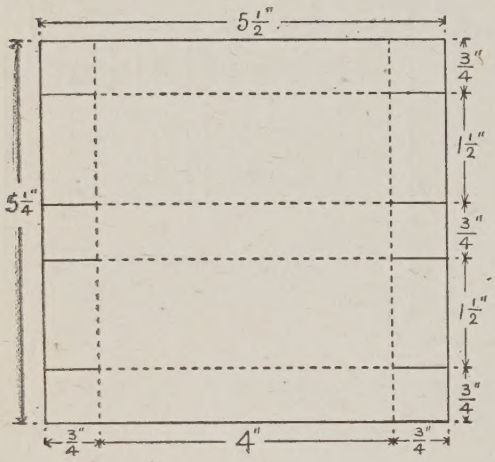
9. *Woven Basket*:

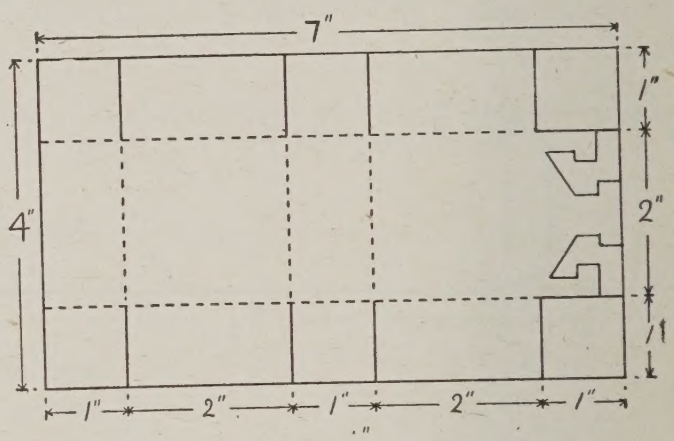
Draw a rectangle 8 in. x 10 in. From each angle measure 2½ in. along each side. Join these points and draw lines half an inch apart. Cut out the four corner squares and fold. Cut along the half-inch lines. Cut three strips half an inch wide. Weave in and out around the basket slightly pasting each end. Bend the remaining portions of the vertical strips outwards. (See page 47)

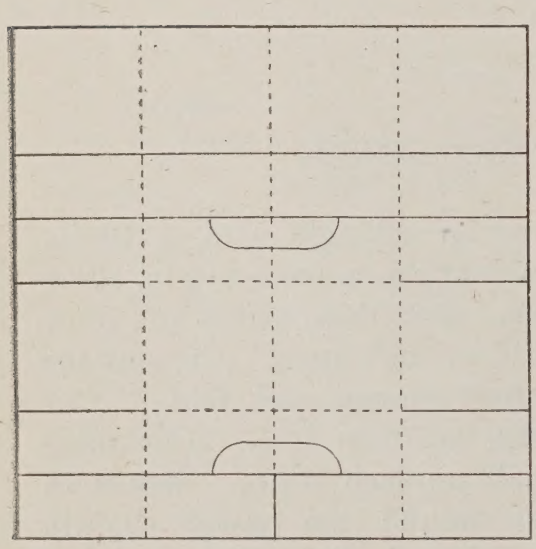
10. *Grandfather's Clock*:

This is made from three boxes pasted together. For the top make a closed box from a rectangle 7 in. x 4 in. Mark the dial as shown on page 47. The middle is cut from a rectangle 5¼ in. x 5½ in. and the base from an oblong 4½ in. x 6 in.



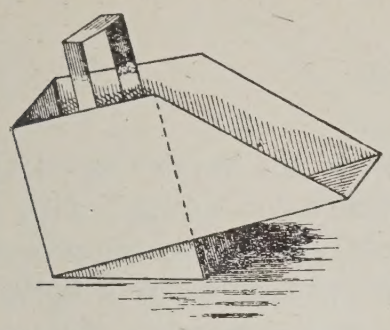


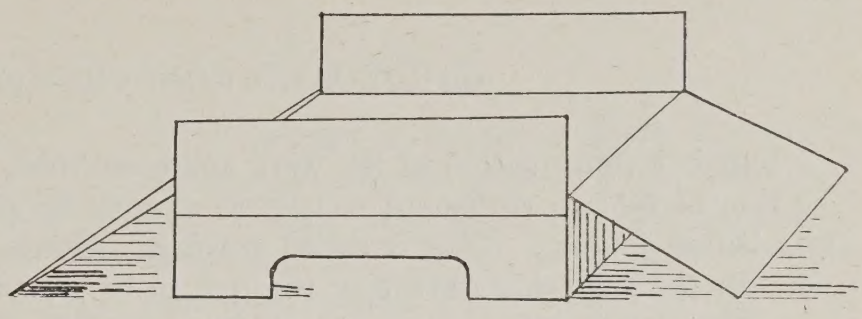


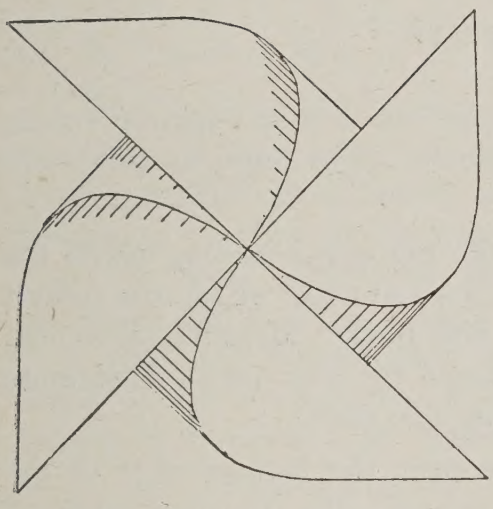


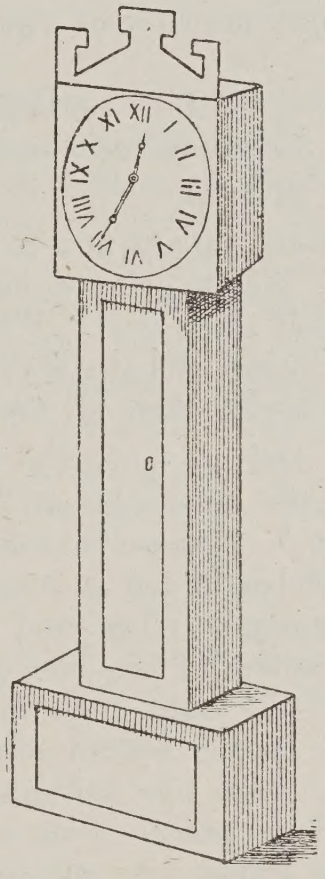
11. *Bridge*:

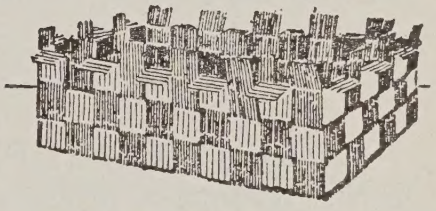
Construct a square having 8 in. sides. Divide into sixteen squares. Cut off one strip of four squares. Fold and cut off half of each of the outside strips as shown. Cut one of these in halves for the upper sides of the bridge. Cut and fold the remaining nine squares as in diagram. Assemble and paste. (See page 47)

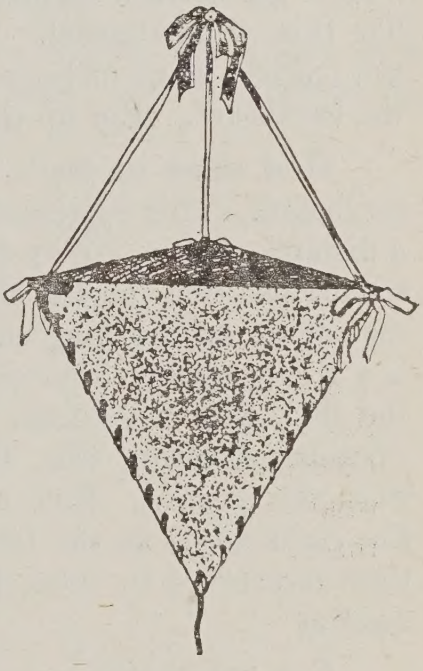


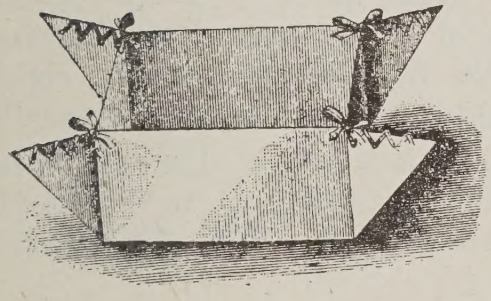


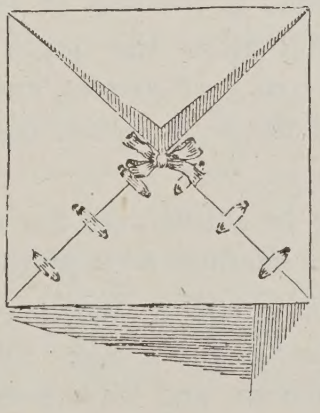


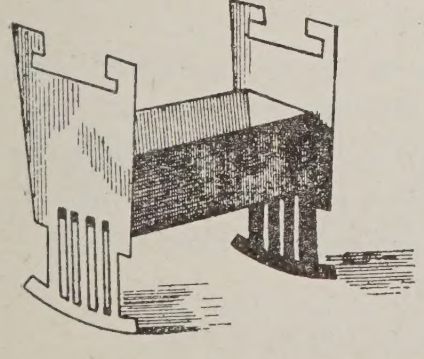


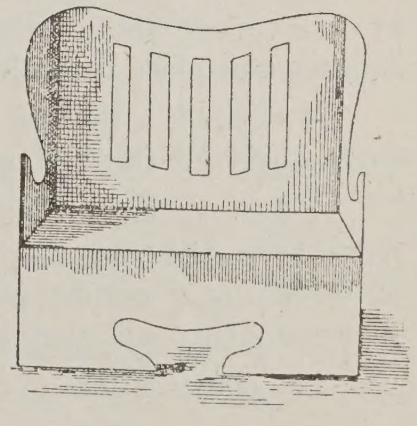












Holder, Cradle, Handkerchief Case, Settee.
Coal Box, Bridge, Windmill, Woven Basket, Paper Box, Grandfather's Clock, Twine

CARDBOARD CONSTRUCTION

This is a continuation of the work above outlined, but in the heavier material. The line of fold in cardboard construction must be partially cut through with a knife before folding. This is called *scoring*. Always fold away from the scored side. In the following drawings, the line to be scored is represented by a dotted line. The designs in most cases admit of modification and originality both in shape and decoration. Wherever possible, the pupils should be allowed to make deviations from the design in accordance with their conceptions of the requirements of the objects. (Plate 27, p. 138)

CONSTRUCTION OF THE SQUARE

Material required: Pieces of thin cardboard to cut a 4-in. square, rulers, pencils, set-square, teachers' model, pieces of red paper. (The pupil at this stage should be familiar with the square.)

Ask for the description and discuss how to make the shape leading up to the correct geometrical method. We are going to make a square mat or picture mount like this. Show model. What shape is it? What size is it? Measure the model and tell us. Four inches each side. What size cardboard will you need? Distribute the cardboard. Pin up the model where all the class can see it.

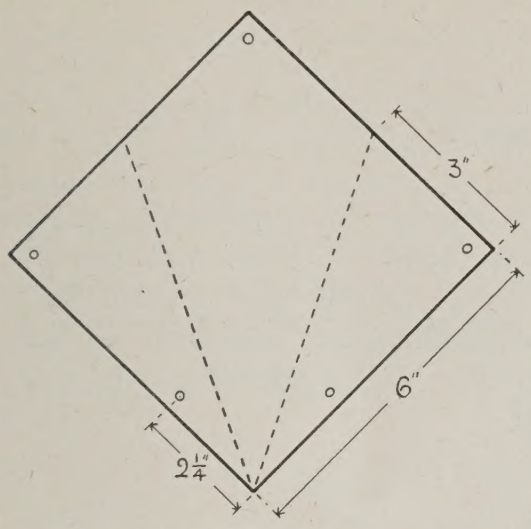
How must we begin? Draw a horizontal line near the bottom edge of the cardboard. This represents the lower edge of the square. On this line mark off a distance of 4 in. Why 4 in.? Because the side of the mat is 4 in. (The teacher should also draw on the black-board, and go round the class quickly to see whether the pupils are working correctly.) What kind of angles must we have? Which is a right angle on your set-square? Place one edge of the set-square just touching the line, with the corner of the right angle at the point marked on the right. (Besides dictating this, the teacher should illustrate at the black-board exactly what she means.) Rule a vertical line upwards. Reverse the set-square, placing the right angle at the left-hand point. Rule a line. On each of these vertical lines measure 4 in. from the bottom line and join the points. Test with the set-square.

Cut out carefully. What else do we need? Two smaller squares of red paper, one for each side. What is the size of these squares? Measure and find out. Distribute red paper and allow the pupils to draw the squares as before, making them 3 in. instead of 4 in. If correct, cut. Measure and mark with a dot at each corner the position of the 3 in. square on the 4 in. square. Paste the red squares and place in position.

If desired, a picture may be substituted for one of the red squares. Ask for suggestions for improving this exercise as a picture mount or frame.

A 2-in. square of white, or a tint of red, may be pasted in the middle of the red square, thus forming a design for a tile. Obtain suggestions for other ways of arranging a number of squares, and have some designs for tiles made. This supermounting will suggest one method of decoration.

The construction of the rectangle may be taught in the same way.



1. *Wall Pocket*:

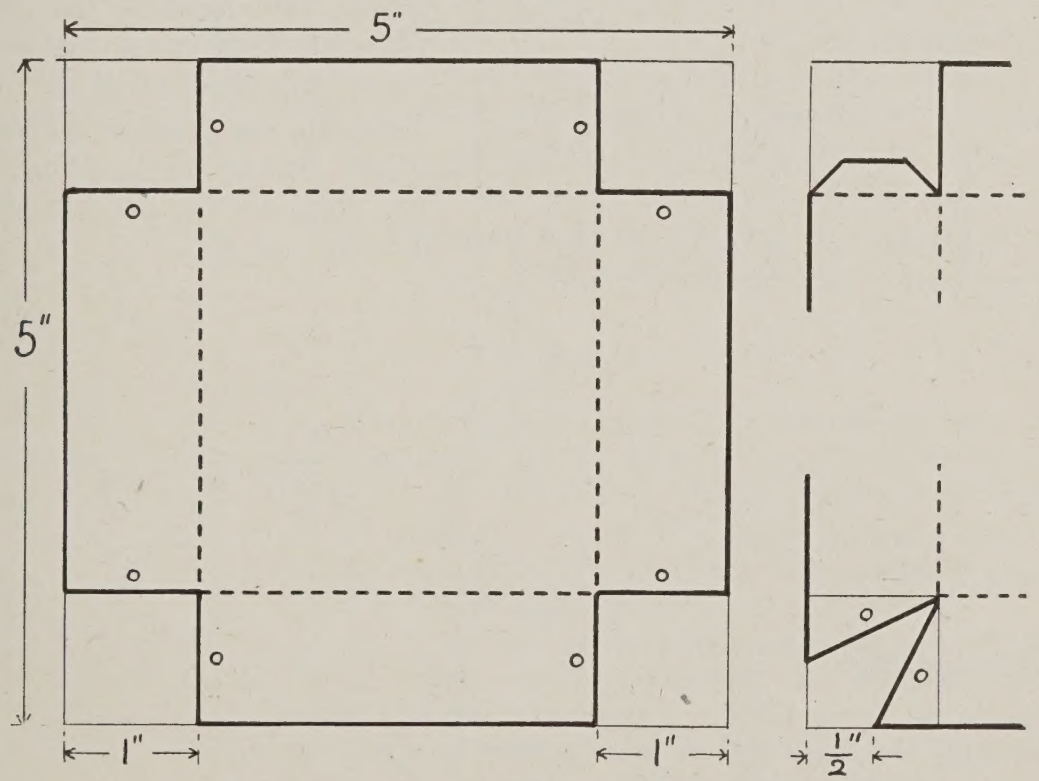
Construct a square. Mark the middle point on two adjacent sides. From these points draw dotted lines to the opposite right angle. Score and fold. Mark where holes for tying should be placed, carefully measuring to get them exactly opposite. Discuss briefly appropriate forms of decoration and have the model completed during a seat-work period when necessary.

2. *Square Tray*:

The teacher should prepare one or two models before the lesson.

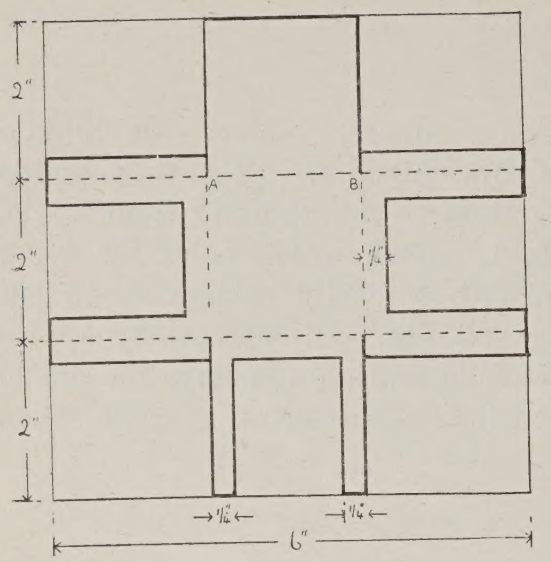
After a brief talk, one of the pupils may untie the teacher's model and tell what materials are necessary and what measurements must be known. The teacher makes the drawing on the black-board according to the pupils' instructions. Cardboard is then distributed and they make their drawings. When these are approved, the cutting, scoring, punching, and tying are done.

After this is made, call the pupils' attention to other objects of a similar type based on the square; for example, envelope, cash-bag, folded box, bed, sideboard, bureau, wall pocket, dog kennel, trough, tent, trunk, etc.



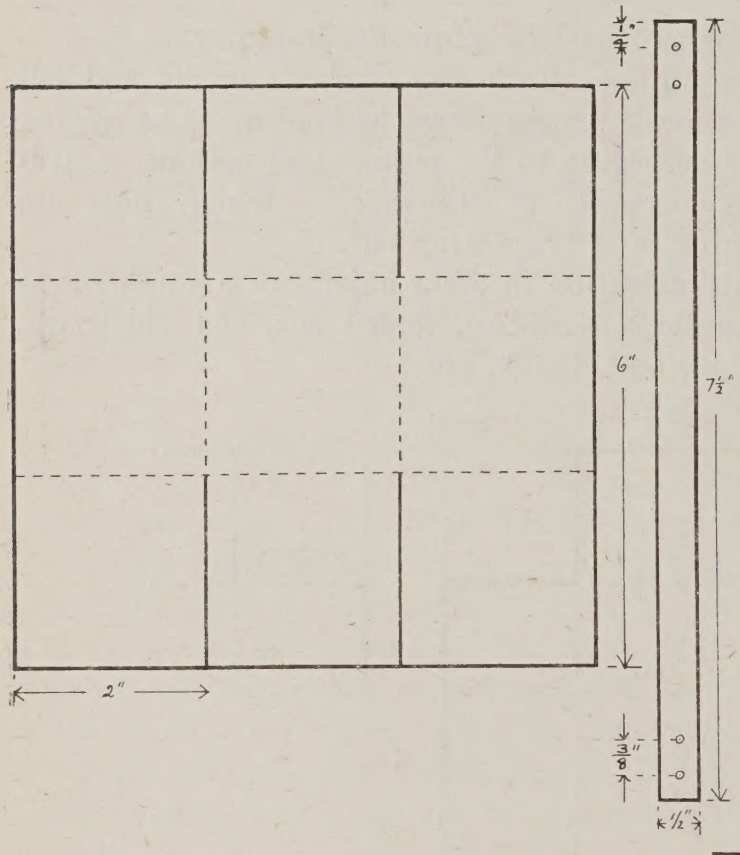
In the earlier cardboard exercises it is best to punch holes and tie the corners. Coloured string, narrow ribbon, or raffia may be used. Avoid large or numerous bows which eclipse the model. Later, provision may be made for pasting all corners or joints by leaving flaps or pieces for pasting as shown i the right-hand diagram.

In the higher grades where greater care and skill are demanded the corners may be cut as for tying and then bound together by narrow strips of paper, linen, or bookbinder's cloth. (See p. 91)



3. *Chair*:

This is similar in construction to the basket shown below. Note that the line AB must be scored on the opposite side. Allow modifications or additions as new shapes for the back—additions of arms, rockers, etc.

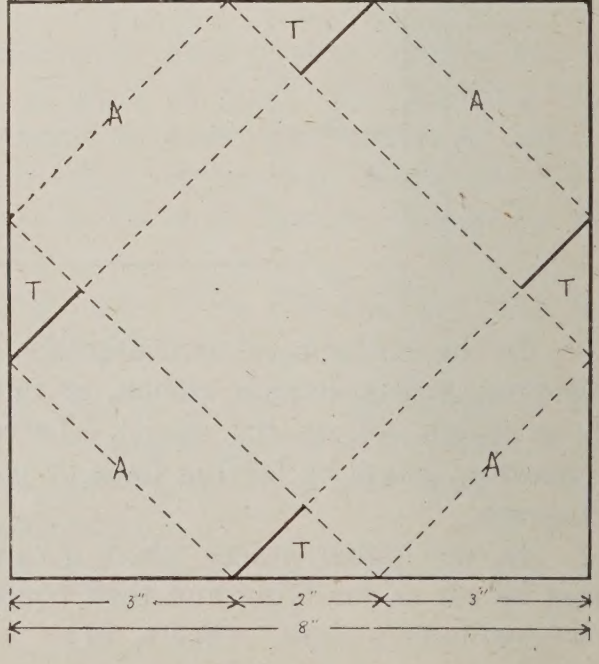


4. *Basket with Handle*:

Construct a square and divide into nine equal squares. Cut and fold as indicated in the figure. Let the pupils try folding the sides into different positions and select the one which appeals to them. Punch holes in the handle. Fold basket. Place handle in position. Mark the place for the holes in the basket. Punch and tie.

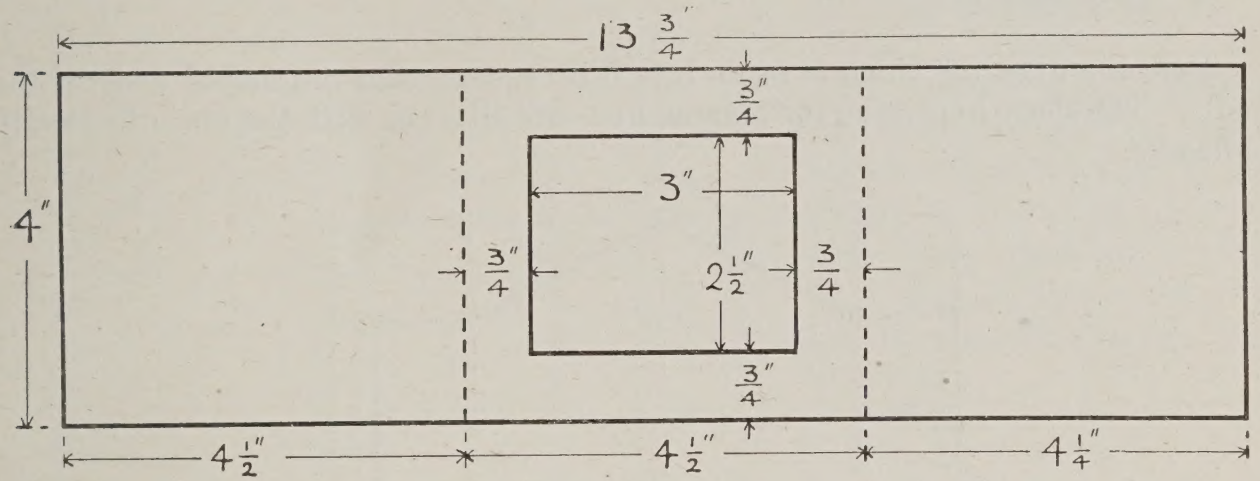
5 *Bon-bon Box*:

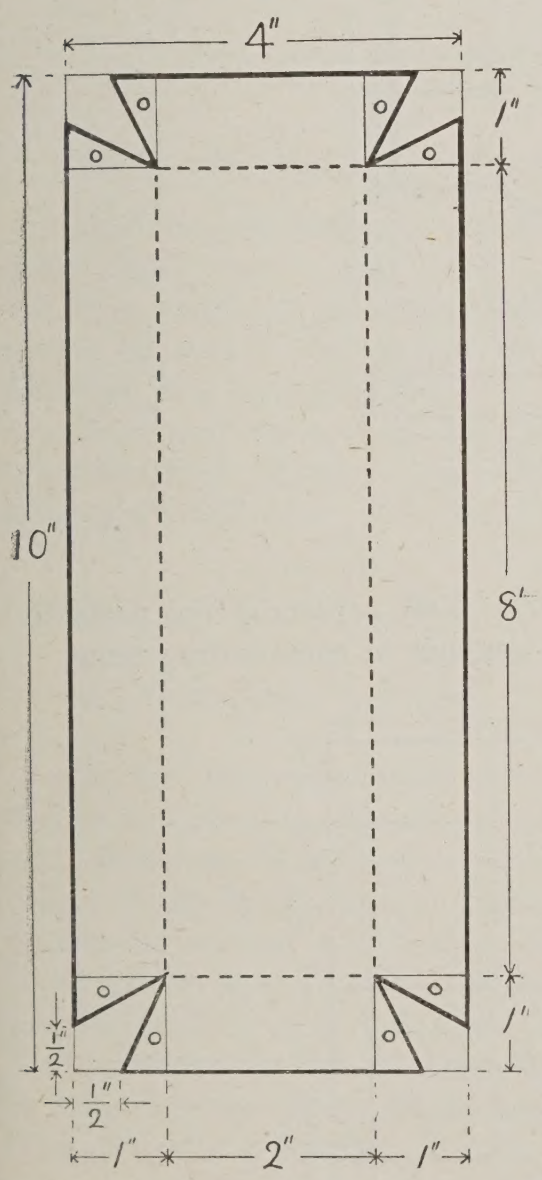
Note the lines marked A which have to be scored on the opposite side. Ends may be pasted, or the triangles "T" may be cut out and the ends tied. Decorate the large triangles.



6. *Photograph Frame*:

To cut out the inner rectangle, draw the diagonals; where they cross, push the scissors through and cut from the centre to the corners; then cut out the rectangle keeping the scissors and the hand under the cardboard. Either tie or paste.





7. *Pen Tray*:

Construct a rectangle 4 in. x 10 in. Measure one inch from each angle along the sides. Connect these points. Measure half an inch from each angle along the sides. Join these points with the angles of the inner rectangle. Mark the position of the holes. Cut to shape, punch holes, score, fold, and tie. The size will contain the average pen. This average should be obtained by allowing the pupils to measure pens of various lengths.

ILLUSTRATIVE LESSON ON A PEN TRAY

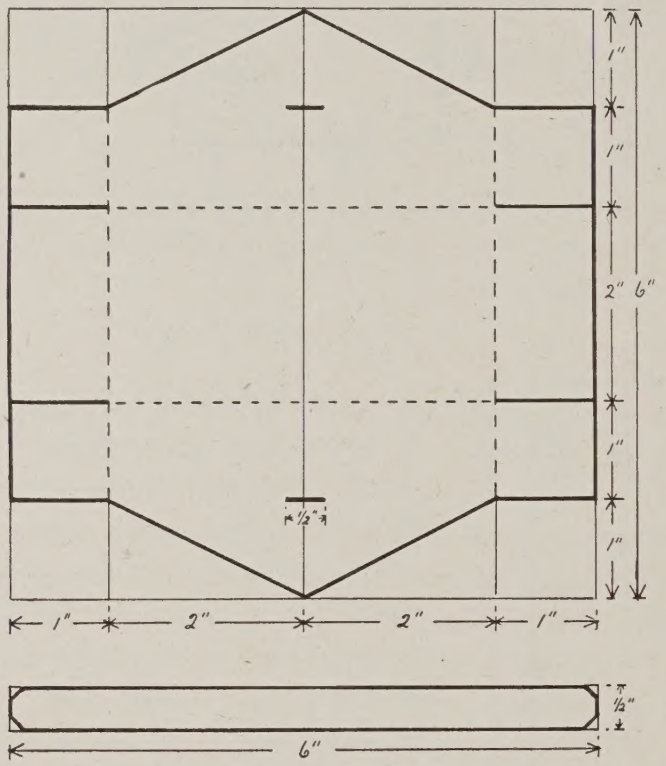
Present trays for examination and measurement. What does the length of the tray depend on? The length of the pens it is to hold. How long is your pen? Seven inches. What should be the length of a tray to hold pens seven inches? About eight inches.

Untie the tray and open out flat. What shape is it now? How shall we start drawing this? Make a rectangle. What size? Four inches by ten inches. What width are the long sides? One inch. Draw them. What width are the short sides? One inch. Draw them. How do we get the sloping sides? By the angles at the corners. Draw them. Measure the bottom of the tray. What are its dimensions? Two inches by eight inches. What is the drawing now made up of? Four squares and five rectangles. What is the size of each? Cut out the shape. How may we bend the cardboard so that it will not break? By partly cutting through. Score along the line of fold. Punch holes and tie to shape.

How can we make this tray with straight sides? By cutting out the four corner squares. Have a tray made with straight sides. This forms the bottom of a box. How will you make a lid? Think of another way of making a lid. Hinge a piece of cardboard eight inches by two inches on one of the long sides.

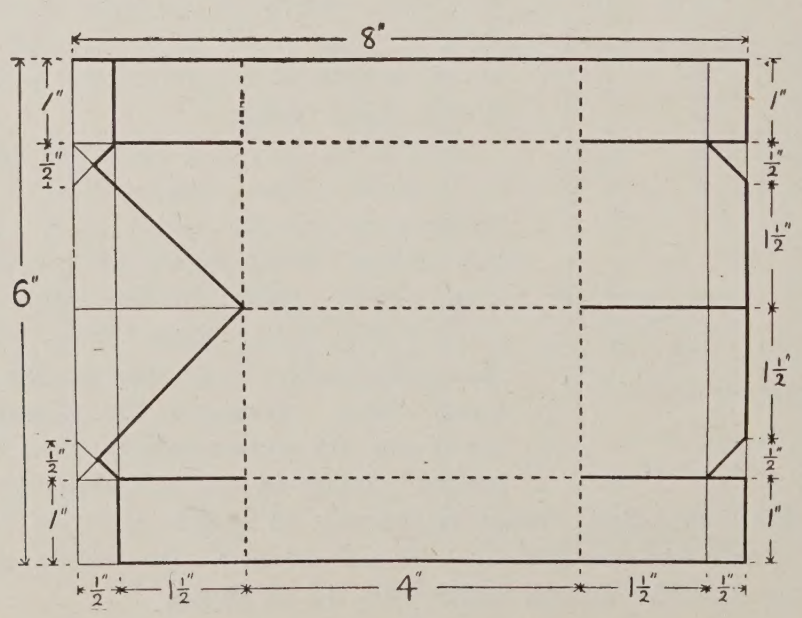
8. *Spool Basket*:

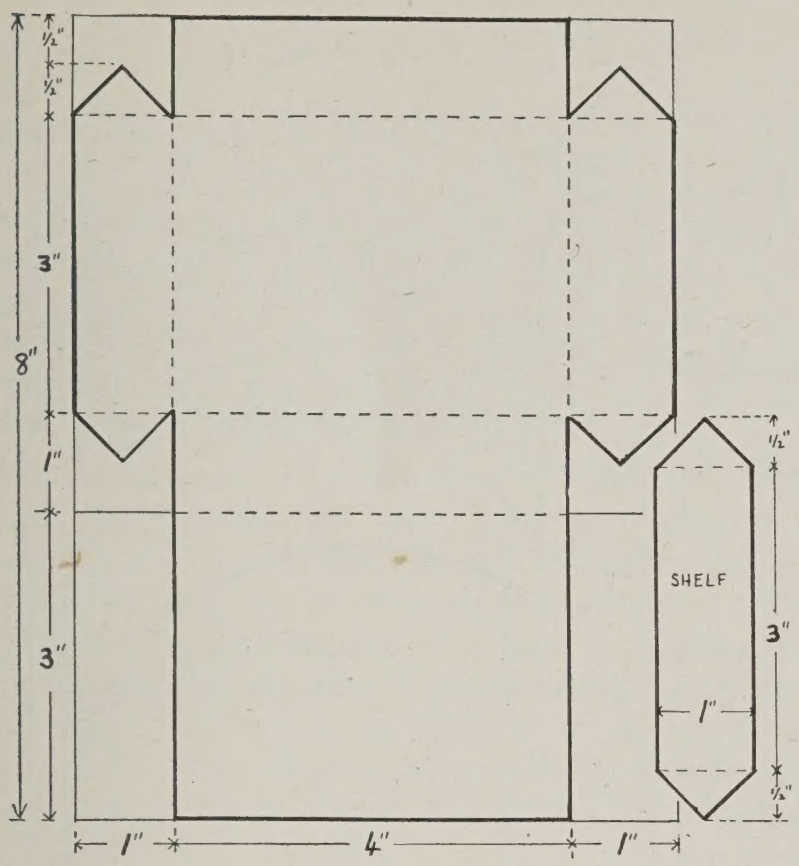
Note the drawing which is made in a 6-in. square, also the shaped ends of the handle. The short lines near the oblique lines are slits cut with the knife to receive the handle.



9. *Wall Tent*:

In drawing the ends follow the plan carefully. Note especially the parts to be cut away. Have the pupils try to invent other methods of constructing tents.





10. *Cupboard with Shelf*:

Let the pupils examine the specimen, and see that it consists of a rectangular box with a lid for the door, and a cross piece added for a shelf. In a similar way a box with any number of divisions may be made.

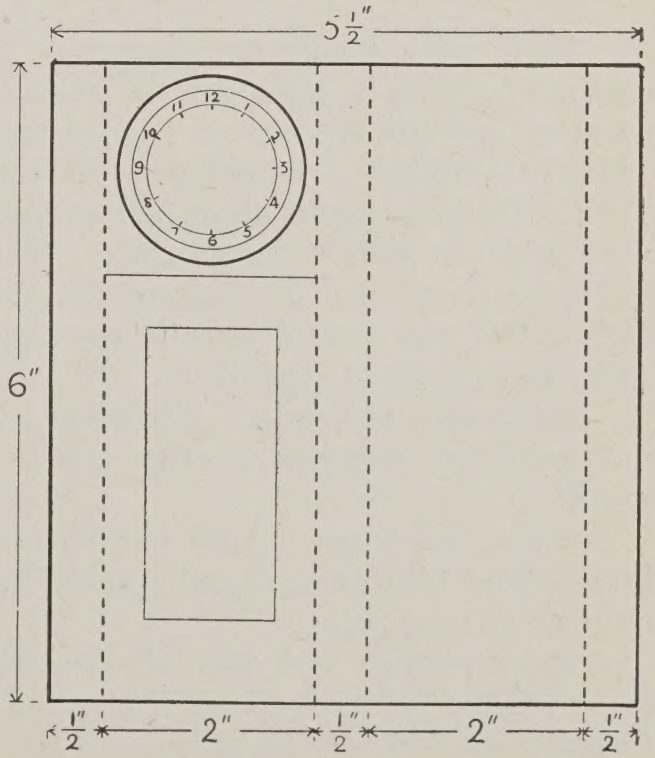
11. *Construction of Circle with Compasses*:

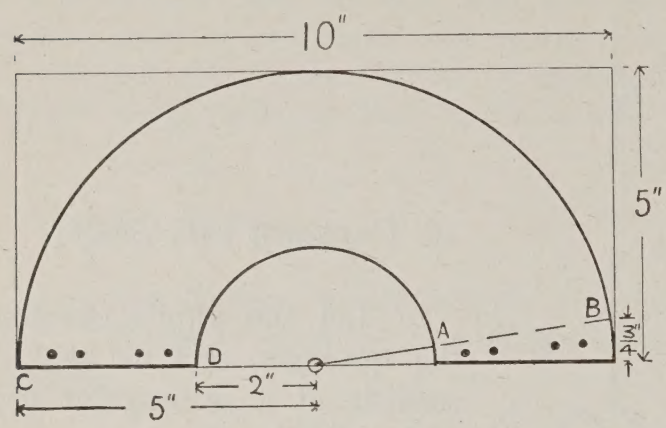
Hold the compass at the top between the forefinger and the thumb. Fix the point lightly and exactly on the required centre and practise until the compass can be revolved in a complete circle making a line of even thickness. The compass should be kept in an upright position. Gradually teach such terms as radius, diameter, and circumference.

Draw and cut a circle of 3 in. diameter. Draw and cut a circle of 2 in. of a harmonizing colour. Paste the smaller one in the centre of the larger one, making a small mat. Give practice in drawing various geometrical designs.

12. *Grandfather's Clock*:

To find the proper position for the figures or numerals use very light lines and draw two concentric circles the height of the figures apart. Draw two diameters, vertical and horizontal, at right angles to each other. This will give the position of 12, 6, 3, and 9. Find the spaces for the intermediate figures by trisecting the right angles between those previously found.



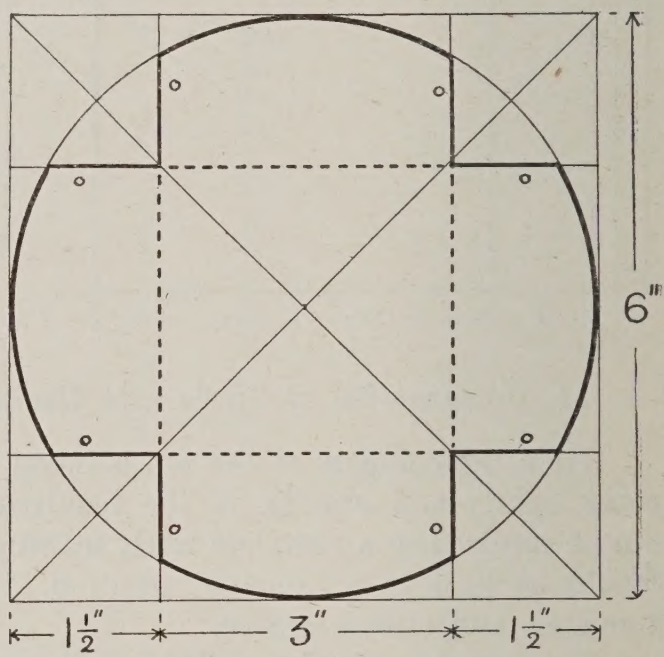


13. *Candle Shade*:

For cutting the inner semicircle cut along several radii, and then cut the curve, having the scissors and hand under the cardboard. Punch the holes in one edge, overlap, and mark the position of the holes in the other edge. Decorate, suiting the style of ornament to the shape of the object. Ask the pupils to invent a wire frame for the shade.

14. *Square Tray with Curved edges*:

Construct a square having sides 6 in. long. Draw the diagonals. Measure 1½ in. from each angle along the sides. From the centre of the square, describe a circle with a radius of 3 in. Complete the drawing as shown. Cut, score, punch, fold, and tie.



MOUNTING PICTURES

Begin with square or rectangular pictures carefully trimmed. Use dark cardboard or heavy paper for the mount. Measure the size of the picture to be mounted and cut the mat to allow equal margins all round. Make a pencil dot where each corner of the picture is to be placed. For first mounting exercises, the picture should be pasted about half an inch along the upper edge. Another method is to paste the four corners lightly. When pictures have been mounted by these methods, others may be mounted by pasting the whole of the back. After the picture has been pasted, place in position, cover with a piece of blotting or waste paper and rub down carefully.

Afterwards experiment with other pictures and mats by placing the pictures in the different positions so often seen in the designs on book covers and calendar mounts.

Sometimes a mat is built up; for example, a dark green sheet is used for the back-ground with white pasted over it. Leave a margin and then paste the picture on the white portion.

Many pictures look very effective when pasted on a white sheet (the white being trimmed off except a small margin) and then pasted on a dark coloured card. Calendar mounts may be built up in this way.

PICTURES

One very useful form of Manual Training is collecting and mounting pictures. These will provide concrete material and teaching aids for lessons in other subjects. (See pages 56 and 63 in the manual on Primary Reading.) The pictures collected should be brought to school, sorted, and arranged in groups according to subjects, for example, those illustrating mountains form one group, those dealing with historical incidents another group, and so on; each group being kept in an envelope or portfolio made for that purpose and properly labelled. A day may be set for revising these groups, selecting from them, and arranging and mounting on sheets of cardboard. They may be kept in a case or box and are always ready for reference as required. In mounting the pictures do not crowd. Twenty illustrations of a mountain are not needed; six will do better. If a large number be mounted on one sheet, the pupils are apt to see the whole indistinctly and not get a clear image of any one. A pupil is more likely to get a vivid impression of a sheep by looking at one, rather than at a flock of twenty. Use few pictures at a time; change them periodically; have three or four hung on the walls and encourage the pupils to study them; young pupils may tell stories about them and use them as a basis for free cutting or modelling; older ones may write compositions. When one set has been thoroughly studied, remove from the frames and replace with others.

FORM III

CLAY MODELLING

Continue the work as outlined in Form II. It is not necessary to enumerate a series of models as it is impossible to draw a hard and fast line between the work of the different Forms, or to grade the models according to difficulty. What is interesting to one pupil may not appeal to another. A model is often well done because the pupil likes it, whilst another is indifferently done because the pupil lacks the stimulating influence of interest.

The distinction between present and previous modelling should be one of detail, finish, and character in the completed object, rather than one of difficulty of execution.

Any teacher desirous of making a special study of clay modelling for carrying the work through all Forms, should prepare himself by taking a course of practical lessons under a competent teacher and by consulting the various books recommended.

POTTERY

Pottery may be built up, in the manner previously described, by the addition of small pieces of clay until the desired shape is obtained, but the following method, adopted by primitive races, is the one most suitable for young children.

The clay is made into rolls about half an inch in diameter. For a base, a roll is taken and formed into a coil. The V-shaped spaces between the coils are filled by spreading the clay, under pressure of the thumb or a flat tool, during the process of making the coil. (Plate 28, p. 139)

If the pressure is directed from the outer edge toward the centre, the original thickness can be maintained or even increased; but with the pressure in the contrary direction the base is made larger and very much thinner. This " direction of the pressure " must be attended to throughout the work.

After showing the pupils how to make a base, let them gain skill by actual practice. Many will make the pressure stroke from the centre outwards and so make their bases too thin.

Question the pupils as to the manner of getting the base back to its original size and thickness. Some will put more clay on the top of the slab and cut off the superfluous clay along the outer edge. Others will find that they can squeeze it back to its proper shape by hollowing the hands and pressing the slab on all sides at the same time; whilst others will suggest patting on the modelling board in the way familiar to them when making mud pies.

Having secured a good flat upper surface, turn the circular slab over and repeat the process until both sides are made smooth. The spaces should be well filled, and the whole slab of clay worked to an even consistency; otherwise, during the drying process, cracks will appear between the coils.

When a satisfactory base has been obtained, the pupils should be required to fix in their minds the shape of the article to be made. Carefully examine the object it is proposed to model. Where it is not possible to obtain the actual object have the pupil make an outline sketch of the proposed model. If during the modelling the pupil wishes to improve his work by changing the design, he should by all means be allowed to do so.

A reference to the photographs given of this operation will show how the size of the vessel being made may be increased or diminished by changing the position of the coil. (Plate 29, p. 140)

Having mastered the principle of enlarging or decreasing to make any particular shape, it would be well to draw the attention of the pupils to the difficulty that some of them had in keeping the bases the correct diameter and thickness.

Question about this and have them find out, if possible, in which direction the pressure stroke should be exerted so as to retain the proper thickness of the sides.

As the base was lying on the modelling board, when it was being pressed into shape, the pupils had the benefit of the resistance offered by the board to the pressure of the thumb. In the sides of the model there is no such resistance, and this must be furnished by the hollow hand held on the outside when modelling the inside of the subject, and by the fingers on the inside when modelling the outside. From their experience in making bases they will probably suggest making the pressure stroke toward the base, which in a general way is correct. (Plate 30, p. 141)

Owing to lack of sufficient pressure by the hollow hand when modelling the inside, many of the pupils will make the object spread too much. To show how to correct this, let them experiment with a small piece of clay or part of a roll, and try to find out how this can be made thicker and shorter. This can be done by taking one end of the small roll between the fingers and thumb of one hand and the other end between the fingers and thumb of the other hand, and gently bringing the two hands nearer to each other.

Apply this principle to those models which have become too large in circumference, taking care, however, not to spread the clay away from the base. This calls for two distinct directions of pressure—(*a*) from one hand to the other, (*b*) downwards toward the base. This pressing into shape should be attended to as each coil is applied; for, if left until several rolls have been laid in position, the work will be much more difficult. The upper portion of the object can be curved as desired.

Avoid making pottery less than three eighths of an inch thick.

To get the appearance of thinness, squeeze the edge of the model between the fingers and thumb for a very short distance only, using, in addition, a pressure stroke directed from the edge of the object toward the more solid portion.

In clay modelling avoid all large pieces of thin clay, as such are likely to crack.

LEAVES AND SHELLS

In modelling thin objects from nature, such as leaves or moderately flat shells, the models should be built up bit by bit, upon a slab, until the desired relief is obtained.

Begin by blocking out the shape (that is, not showing too much detail) a little smaller than that of the finished object. Build up to the required shape. To give the appearance of thinness, cut away a sufficient amount of the supporting clay. Such objects are usually modelled to be viewed from one direction, and, generally speaking, the supporting clay should not be seen when so viewed. In many cases, however, it is impossible to avoid seeing some of the clay backing; for example, where the edges of leaves or flowers are doubled inwards, and also in the case of the stems.

RELIEF MAPS

Show the pupils that the outline of a map is really a portion of a plan of an object. Demonstrate this by taking any convenient object, placing it on a sheet of paper, and drawing round it with a pencil. Remove the object and an outline plan remains.

Gradually increase the number of objects until you get a plan of the classroom. Use strips of plasticine to represent the walls. Leave spaces for doors. Make suitably shaped blocks of plasticine to represent desks, tables, cupboards, etc. Place these in position. Draw round them. Remove the plasticine, and an outline plan remains.

Get the pupils to grasp the idea that, if they could lift up an island and put it on a piece of paper and draw round it, they would get an outline plan which is the same as the outline of a map.

Proceed a step further and develop an outline plan of the immediate district in which the school is situated, showing roads, buildings, etc. The outline so obtained is a map of the district.

Let the relief maps be of a bold, general character and directly connected with the lessons in geography.

GEOGRAPHICAL FORMATIONS

Island: Begin with a well-known island. If the school is so situated that the pupils can see one from the school grounds, or in some nearby pond or stream, let them model directly from this, or study its shape sufficiently well to get a clear idea of it.

Give each pupil a piece of cardboard about 8 in. x 10 in. On this draw the outline of the island a little smaller than the size of the proposed model. Then take small pieces of clay and build up the general shape of the surface inside this outline. Go over it again and again until the desired shape is obtained.

In the larger islands show the course of the rivers by depressions, taking care that the course of the river has a downward trend toward its outlet. Discuss with the pupils what would take place if high land obstructed the path of the river. When the river rushes over high rocks and drops suddenly, a waterfall is formed.

Lake: Select a well-known local lake or pond if possible. Treat it in a manner similar to that of the island, building up the model *outside* the outline. This gives greater scope for the discussion on rivers and land formations generally.

Coast Formations: Proceed, in a similar manner, to build up gulfs and bays and other coast formations. Have similar formations pointed out on the map. Let the pupils build up imaginary pieces of coast or other land formations to represent some definite feature. This will show clearly whether they really understand the various geographical terms.

Mountains: Build up as before. Discuss the influence of mountains upon the direction of the rivers.

Cliffs: Caves and river mouths can be well demonstrated in this manner.

Relief maps showing the main features of a particular locality may now be attempted. Draw the outline and build up (in much lower relief) as before, show the towns by small beads of plasticine.

PERMANENT RELIEF MAPS

If it is desired to make permanent maps, use the special modelling material as described in the chapter on "Materials and Equipment."

One of the great advantages in using the salt and flour mixture lies in the fact that the rivers, lakes, and other waters can be coloured as in ordinary maps and the towns located by dots, whilst snow-capped peaks may be left white and the remaining portion of the mountains coloured in greens and browns, etc., to represent the chief characteristics of the land. Tracts devoted to the cultivation of grain of various kinds may be coloured to some shade of orange, etc.

PAPER CUTTING

The work of Form III in this material will be a continuation and extension of that previously done. Many of the earlier problems suggested will be suitable here also, but greater attention should be given to detail, character, and arrangement. The powers of execution and observation hitherto developed will lead to more accurate and artistic results. The units used may be smaller and should be more largely employed for purposes of decoration and design. (Plate 31, p. 142)

Many of the cardboard models hereafter described may be appropriately decorated with paper cuttings of various kinds. The conceptions formed of the significance of special days and seasons, historical incidents, and geographical facts, will differ materially from those formed at an earlier stage, and will be expressed in more elaborate and detailed cuttings. (Plates 32-35) At this stage much greater use should be made of coloured paper—radial border, and all-over patterns may be effectively designed. By the use of different colours it is possible to produce pleasing pictorial compositions in flat colour tones. Suitable subjects for this work are simple landscapes and seascapes, feast of lanterns, maps, stories. In fact, practically all the suggestions previously given can be worked out in coloured paper. As an illustration of this, take the "feast of lanterns" made at Hallowe'en. This may consist of a fence (medium gray green), grass (dark green gray), background of black paper, and lanterns (orange-yellow) with eyes, nose, and mouth openings filled with light yellow.

Attention should be paid to the general arrangement in order to secure a pleasing composition. The centre post of the fence should be well to the right or left of the centre of the picture. Place the pumpkins in different positions, and see that the grass occupies less than one third the picture space in order to give room for the fence with its lanterns.

CARDBOARD CONSTRUCTION

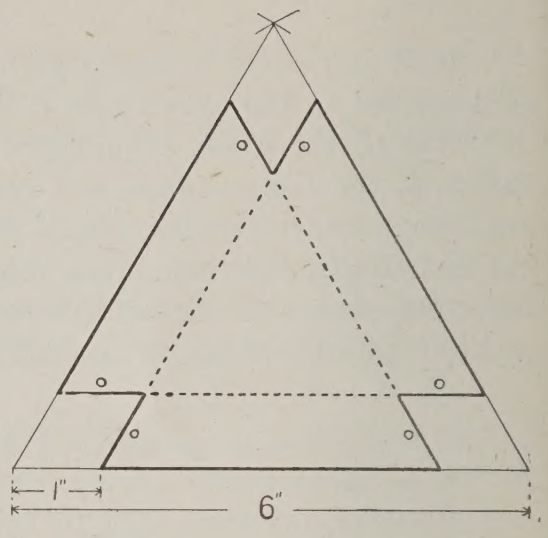
Construction of the Triangle:

The previous lessons in paper folding have included the formation of the common triangles. These should now be used in reviewing what has been learnt about the triangle.

The geometrical constructions of the various figures required in the making of the following models are given in the geometrical problems outlined for this Form.

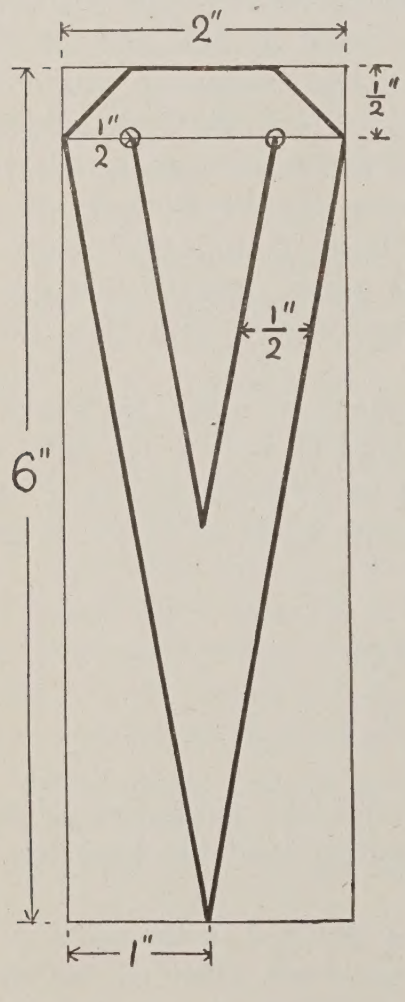
TRIANGULAR TRAY:

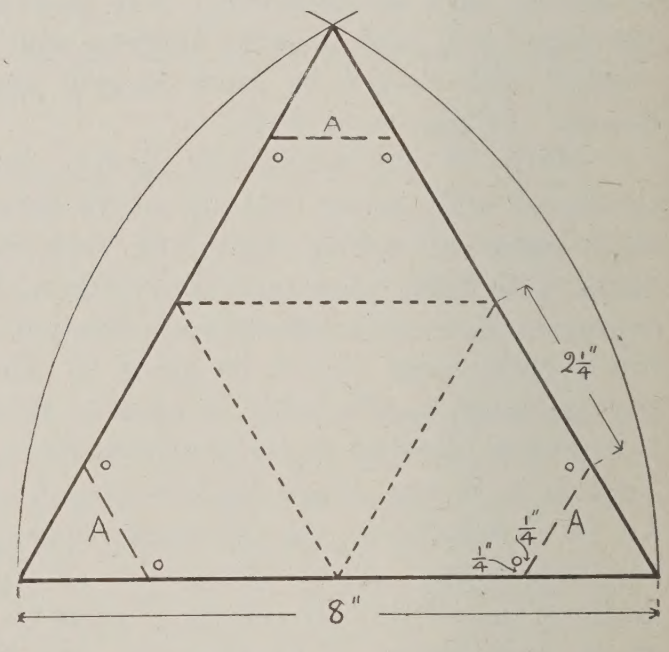
Construct an equilateral triangle of a given size. Complete the figure according to the drawing. Cut out corners. Punch holes, score, fold, and tie. Review methods of fastening corners.



BOOK MARK:

Construct a rectangle 2 in. x 6 in. Make drawing as shown noting parallel line. Punch holes and cut along heavy lines.





TRIANGULAR CANDY BOX:

Construct an equilateral triangle of 8 in. sides.

Find centre of each side.

Join these points.

Draw remaining lines according to measurements given.

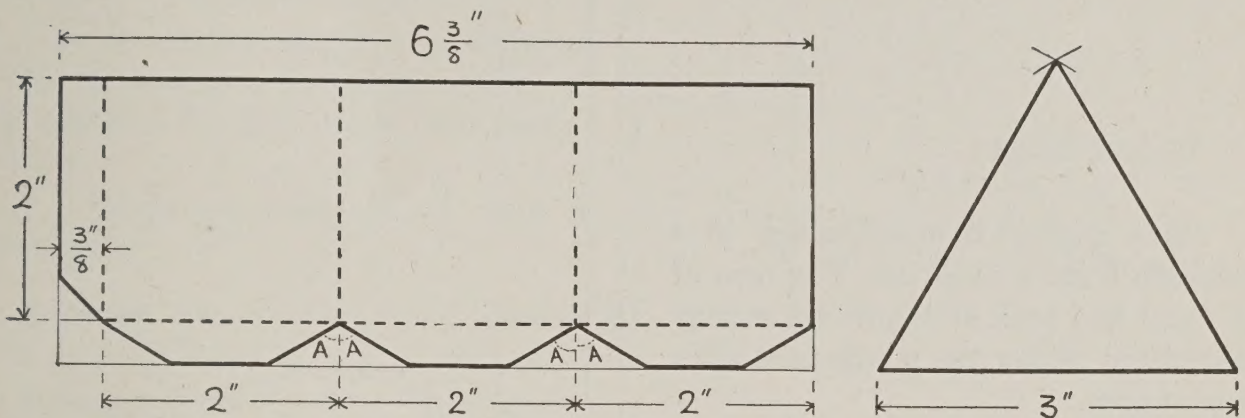
Punch holes.

Fold and tie.

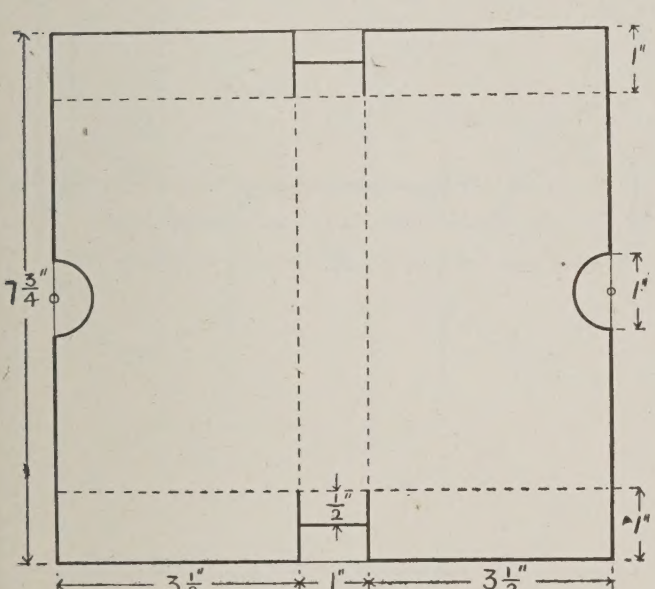
Lines marked A should be scored on the opposite side.

TOOTHPICK HOLDER:

Construct an equilateral triangle on a 3-in. base.
Construct a rectangle 2⅜ in. x 6⅜ in.
Score and fold to shape by pasting the flap on the short side of the rectangle.
Paste remaining flaps and fix to base.



Hold flaps in position from the inside until the paste is set. The angles at A must be slightly more than 60 degrees, otherwise the flaps will overlap.



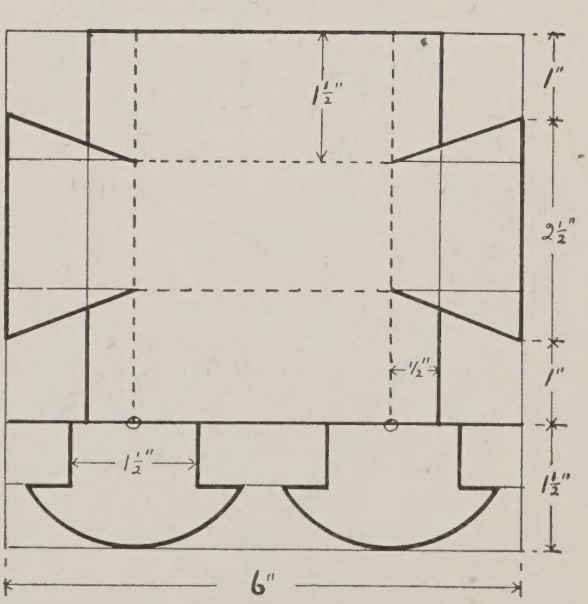
POST-CARD HOLDER:

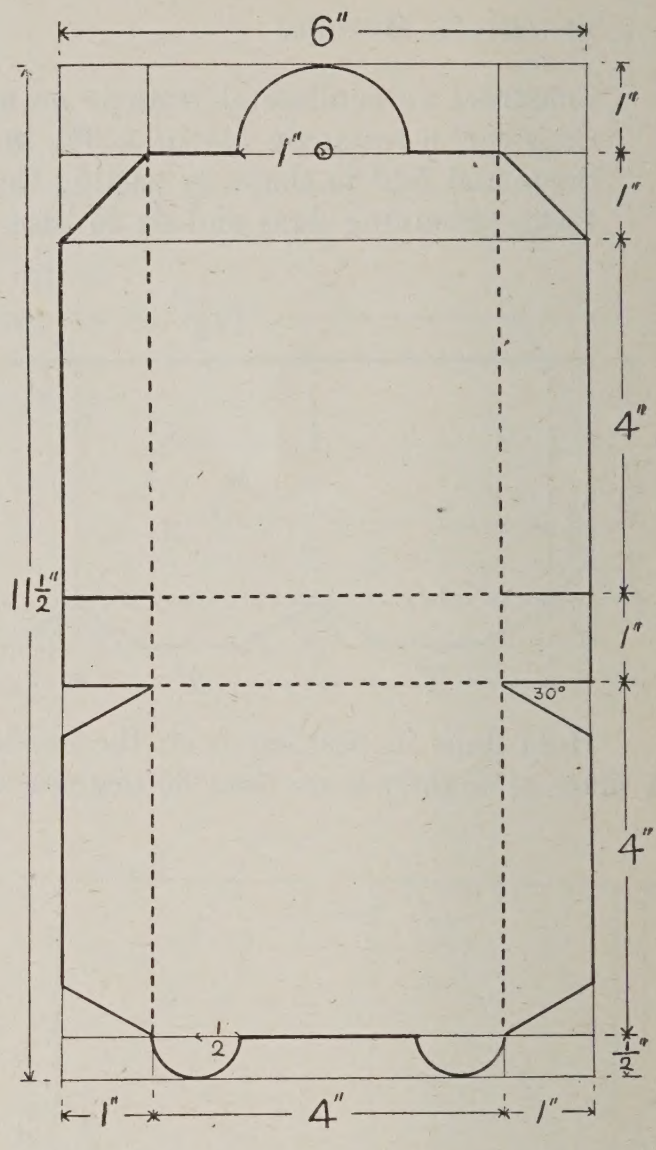
Construct a rectangle 7¾ in. x 8 in. Complete the drawing. (The small semicircles may be drawn with compasses, or a one-cent piece may be used as a templet.)

Cut, score, fold, and paste.

CRADLE:

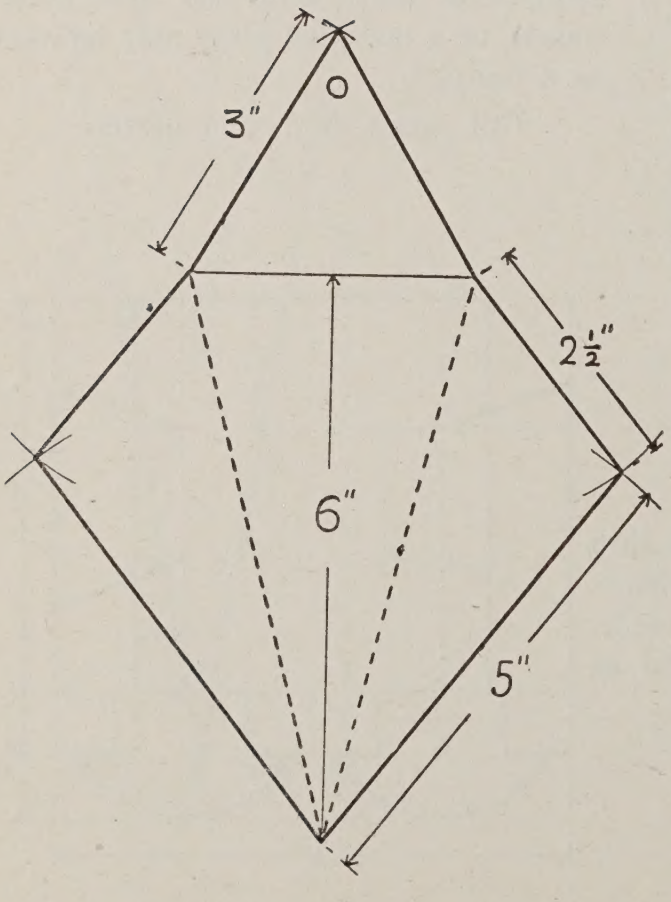
Construct a 6-in. square. Divide into four equal rectangles. Complete the drawing. The design of the ends may be modified by the pupils. Finish the model as previously described.





LETTER RACK:

This model is constructed in a rectangle 6 in. x 11½ in. The tops of the front and back as shown are merely suggestive. Allow the pupils to modify these shapes.



TRIANGULAR WALL POCKET:

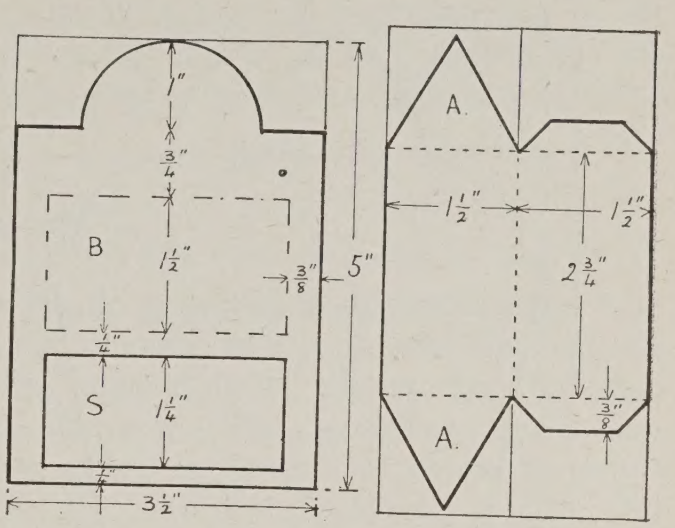
This is an exercise on the formation of three different kinds of triangles—equilateral, isosceles, and scalene. For the method of constructing these see the geometrical problems given for this Form. The model is finished in the usual way.

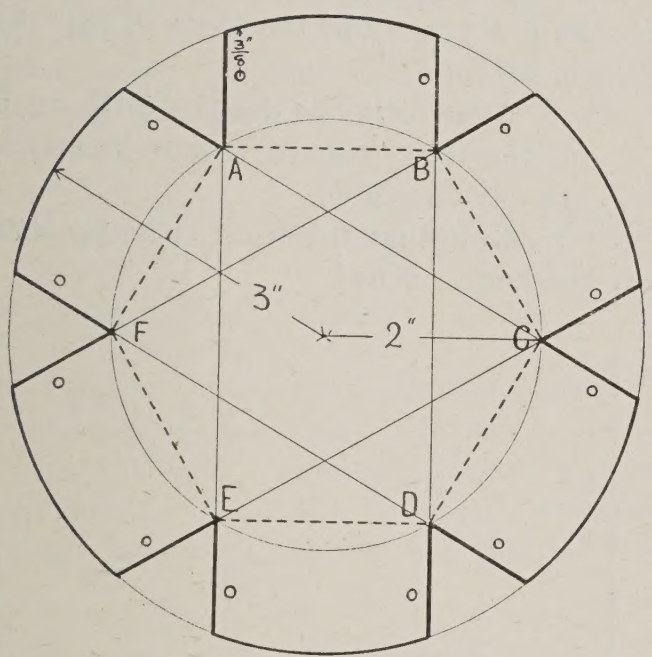
Match Box:

For the back construct a rectangle 3½ in. x 5 in. S represents sand-paper, B the space the box is to occupy. A design for the top is suggested.

For the box construct a rectangle 2¾ in. x 3 in. Construct equilateral triangles (A) and draw the pasting flaps.

Boxes of other shapes may be designed.





Hexagonal Tray:

Describe two concentric circles of 2 in. and 3 in. radius respectively. In the smaller circle inscribe a hexagon as shown in geometrical problem No. 23.

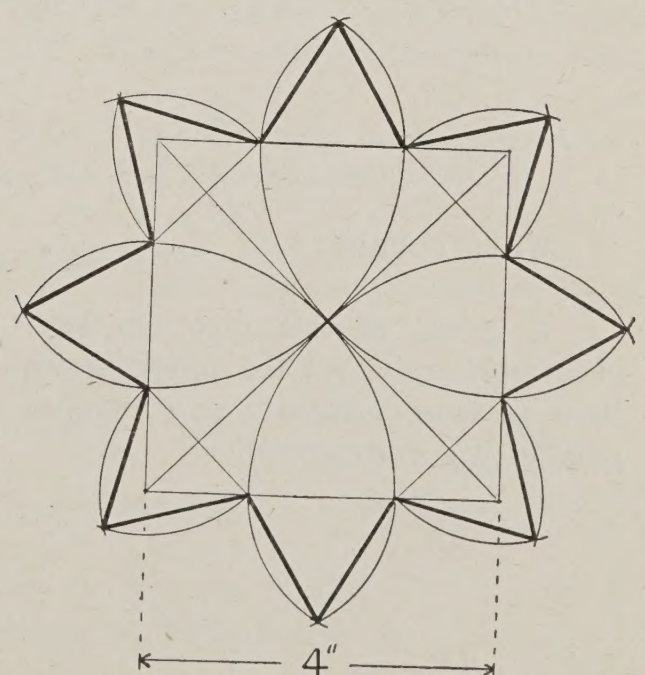
From the circumference of the larger circle draw lines through points AC; BD; CE; DF; EA; FB.

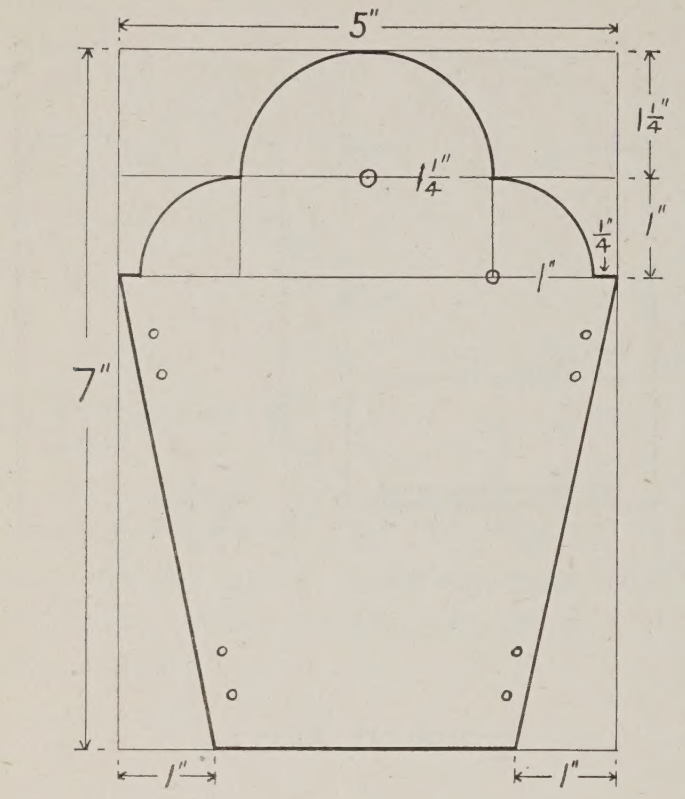
Cut, punch holes, score, fold, and tie.

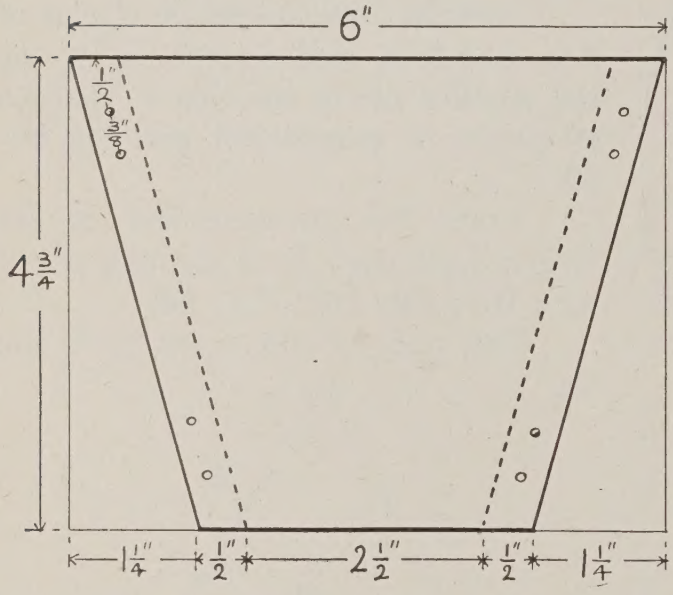
Eight Pointed Mat:

Construct a square with 4-in. sides. Inscribe a regular octagon as shown in geometrical problem No. 26.

On each side of the octagon describe an equilateral triangle.







WHISK HOLDER:

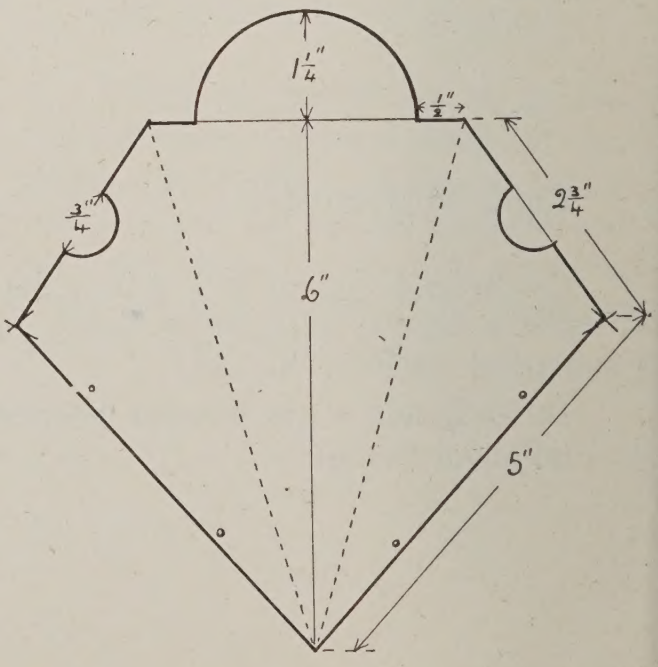
The back is formed in a rectangle 5 in. x 7 in., and the front in one 4¾ in. x 6 in.

Allow original designs to be made for the top. The front may be appropriately decorated.

Note that the front is larger than the back. Why?

WALL POCKET:

A model of this type has been given previously, but the design shown here is more elaborate and requires greater care in construction.



The exercises in construction given above should be regarded as types only. Each one admits of many modifications both in design and size according to the purposes it is intended to fulfil. For example, if the whisk possessed by one pupil differs in size from that possessed by another, the holder made should differ in size accordingly.

DECORATING

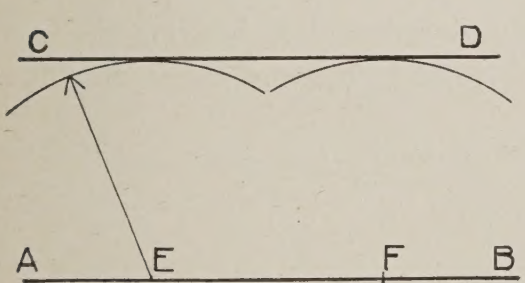
Paper and cardboard models may often be improved in appearance and usefulness by some form of decoration. This should take a simple form in the earlier exercises, and may consist in the application of crayon, free cuttings, and pictures or designs worked in coloured paper. The decoration should conform to the shape of the object and be appropriate to its use. It should be simple and not overcrowded. The object comes first and the decoration second. We must not lose sight of the model in seeing the adornment. Simplicity and harmony are the two main principles to remember. (Plate 36, p. 147)

With reference to colour, it is best to confine young pupils to combinations of grays with spectrum colours and dominant harmonies, that is combinations of various tints and shades of one colour.

MECHANICAL DRAWING

GEOMETRICAL PROBLEMS:

A series of basic geometric problems is given, as all the constructive work in cardboard and in wood, and all mechanical and working drawings depend upon such problems. In every problem presented, the teacher is advised to stress the geometrical principles involved. Correct working methods at this stage will do much to secure accurate and finished workmanship in all future operations.



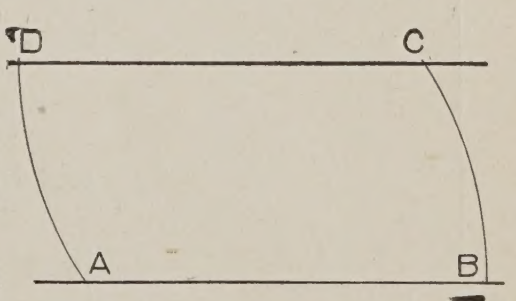
1. *To draw a line parallel to a given line AB*:

Take any two points E and F on the given line AB. Describe arcs at the required distance.

Draw line CD tangential to these arcs.

CD is parallel to AB and is drawn at the required distance from AB.

2. *To draw a parallel line through any given point*:

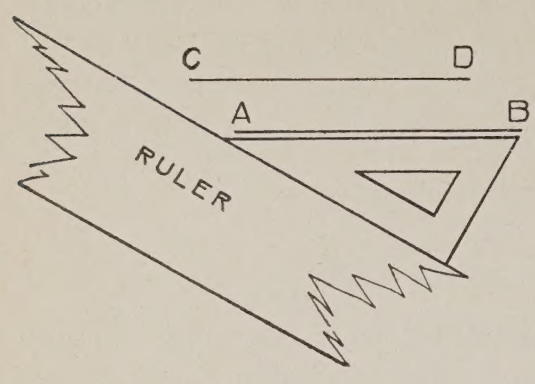


Let AB be the given line and C the given point. With C as centre and any convenient radius describe arc AD.

With A as centre and with the same radius describe arc CB.

Make AD equal to CB. Draw a line through points CD.

CD is parallel to AB and passes through the given point.

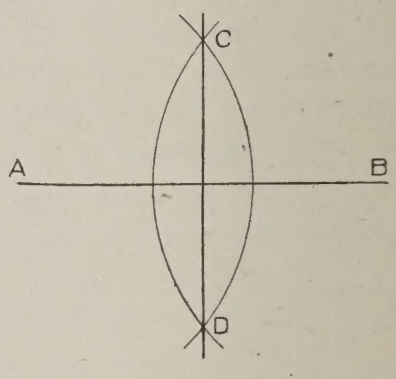


3. *Mechanical method of drawing lines parallel to other lines*:

Place the ruler and set-square in such position that one edge of the set-square is on the given line, then slide the set-square along the edge of the ruler to the required point through which the parallel line is to be drawn as at CD.

Note: A similar result may be obtained by using two set-squares.

4. *To bisect a line and also to draw a line perpendicular to another line, through its centre.*



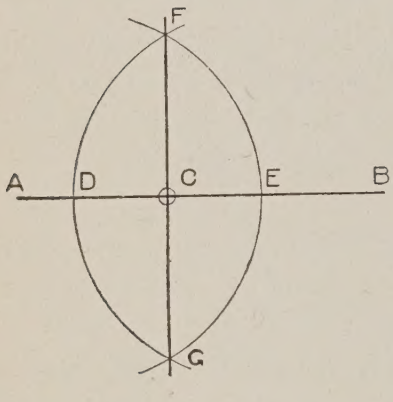
Let AB be the given line.

With A as centre and any radius over half the length of the line, describe an arc.

With B as centre and same radius describe another arc intersecting the previous one in C and D.

Draw a line through points C and D.

The line CD bisects AB and is also at right angles to it.



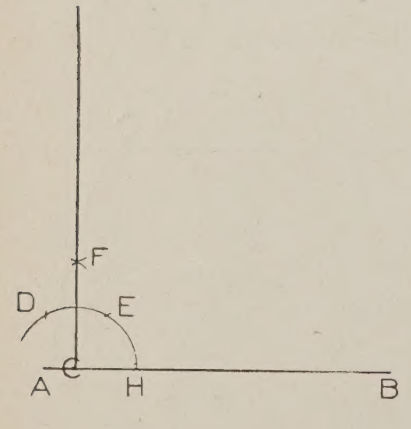
5. *To draw a line perpendicular to another at any given point*:

Let AB be the given line and C the given point.

With C as centre and any convenient radius, mark the points D and E.

With D as centre and radius DE describe the arc GEF, and with E as centre and the same radius describe the arc GDF.

Draw the line FG through the points of intersection.



6. *To draw a line perpendicular to another when the point is at or near the end of the given line*:

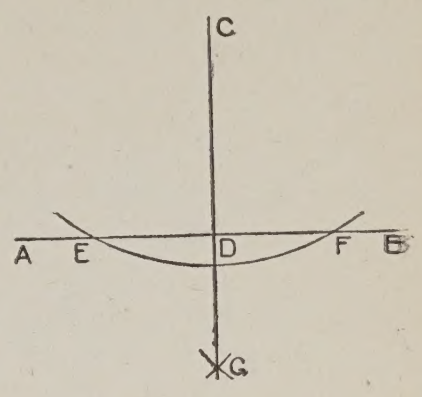
Let AB be the given line and C the given point.

With C as centre, and any radius, describe an arc.

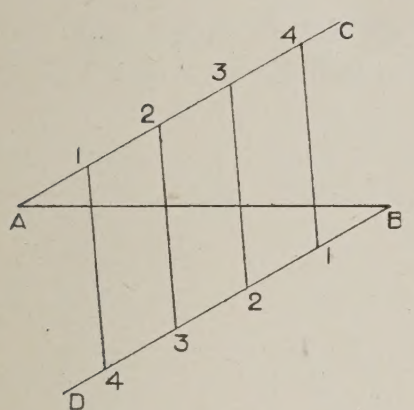
From H with the same radius, mark off points E and D.

With E and D as centres, and any radius, draw arcs intersecting at F. Draw a line from C through F. FC is perpendicular to AB.

7. *To draw a line perpendicular to a given line from a point without the line.*



Let AB be the given line and C the given point. With C as centre and any radius greater than CD, draw an arc cutting the line AB in E and F; from these points as centres, with any radius, describe arcs intersecting at G; from C draw a line through G. CG is perpendicular to AB.



8. *To divide a line into any number of equal parts:*

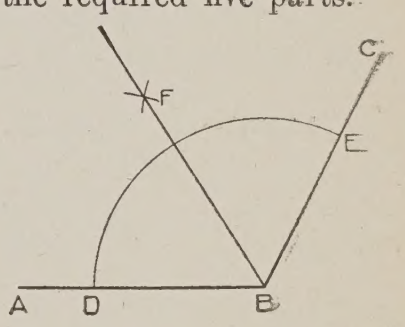
Let AB be the given line to be divided into, say, five equal parts. From one end A, draw a line AC at any convenient angle to AB and from B draw BD at the same angle. (AC will be parallel to BD.)

From A on the line AC mark off *four* equal divisions (that is, *one less* than the required number of equal divisions of the line AB) and from B on line BD mark off the same four divisions.

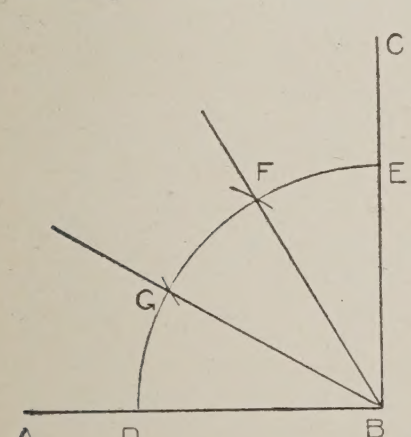
Join 4 to 1, 3 to 2, 2 to 3, and 1 to 4.

This will divide AB into the required five parts.

9. *To bisect any angle, say, the angle ABC:*



From B as centre, and with any radius, draw the arc DE; and from D and E as centres, with any radius, draw arcs intersecting at F; join BF, which will bisect the angle ABC.



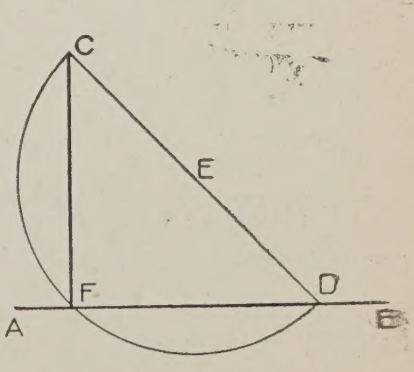
10. *To trisect a right angle, ABC:*

With B as centre and any radius describe an arc DE; with the same radius and D as centre, set off a point F; join FB. Note that BF makes 60 degrees with AB, and 30 degrees with CB.

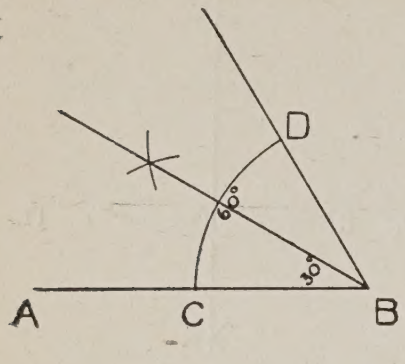
With E as centre and with the same radius, set off a point G; join GB.

GB and FB will trisect the right angle ABC.

11. *To draw a line at right angles to AB from a point C nearly opposite one end of the line:*



Take any point D, not opposite to C, on the line AB; join CD and bisect it in E; with E as centre and EC as radius, describe the semicircle CFD, and join CF. CF will be at right angles to AB.



12. *To construct angles of 60 degrees and 30 degrees*:

At one end of a line AB, and with any radius, describe an arc CD; and from the point C with the same radius, set off a point D; join DB which will make 60 degrees with AB.

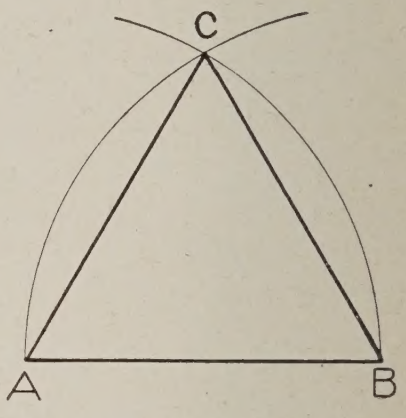
Bisect this angle and the required angle of 30 degrees will be obtained.

Note: If, in the first part of this problem, the arc be extended and two divisions of the radius marked off, an angle of 120 degrees will be obtained.

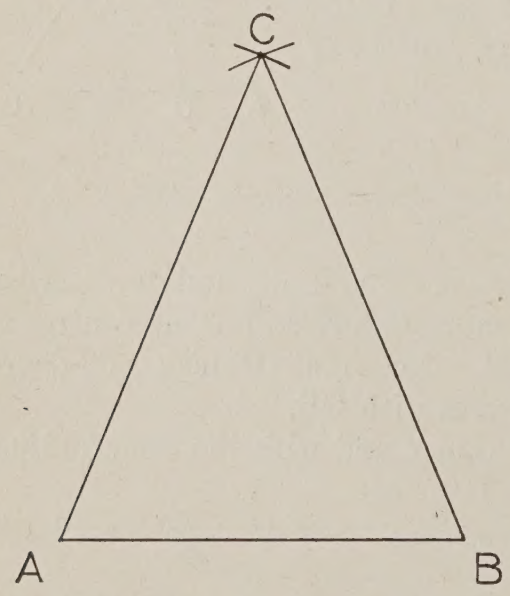
13. *To construct an equilateral triangle on base AB*:

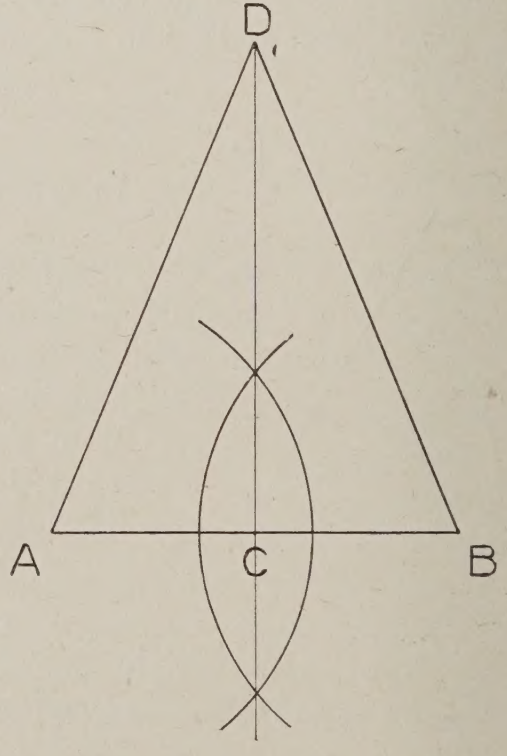
From each end of the line AB, with A and B as centres, and with radius AB, describe arcs intersecting at C; join CA and CB.

ABC is the required equilateral triangle.



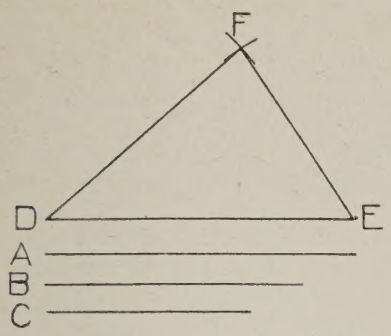
14. *To construct an isosceles triangle upon a given base AB*:





With A and B as centres and the length of side required as radius, draw arcs intersecting at C; join AC and BC.

Bisect AB in point C. From C erect a perpendicular CD (equal to the height of triangle required). Join AD and DB.



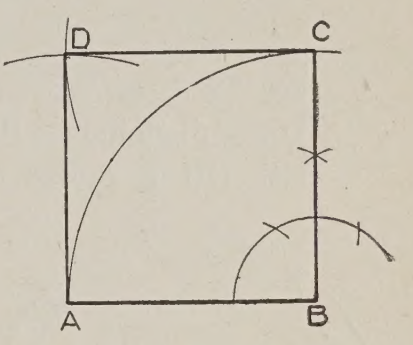
15. *To construct a scalene triangle with sides equal to A, B, and C respectively*:

Make DE equal to A.

From points D and E respectively with radii equal to B and C draw arcs intersecting at point F.

Join DF and EF.

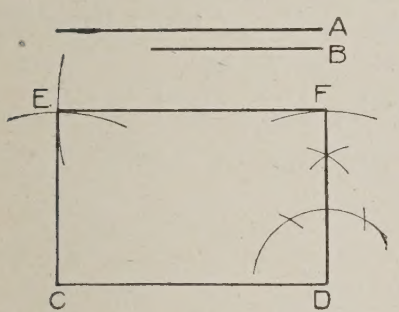
16. *To construct a square on a given line AB*:



At point B erect BC perpendicular to AB and equal to it.

With A and C as centres, and radius equal to AB, draw arcs intersecting at D.

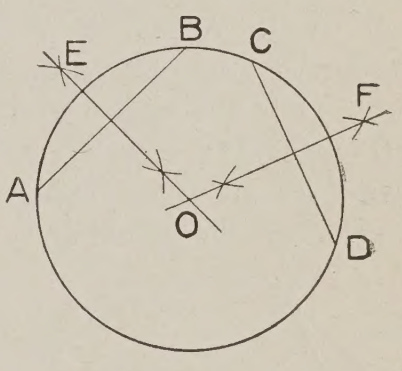
Join DC and DA. ABCD is the square required.



17. *To construct a rectangle with sides equal to A and B*:

Draw the line CD equal to the given line A. At D erect a perpendicular DF equal to the given line B. With C as centre and radius equal to the line B, and with F as centre and radius equal to the line A, draw arcs intersecting each other at E; join EC and EF, which will give the rectangle required.

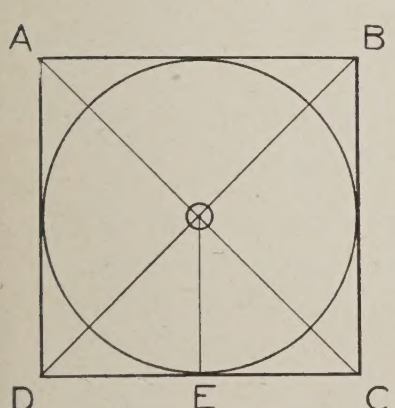
18. *To find the centre of a circle*:



Draw any two chords as AB, CD.

Bisect these chords and produce the bisecting lines until they meet at the point O.

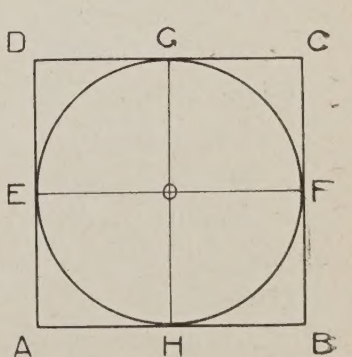
Then the point O is the required centre.



19. *To inscribe a circle in a given square*:

Let ABCD be the given square.

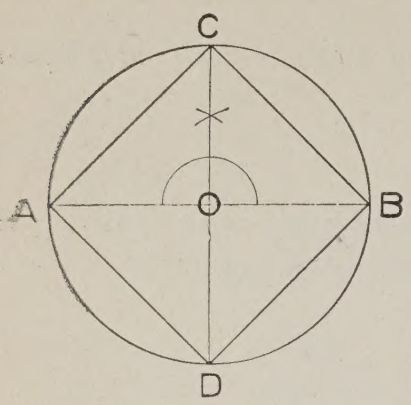
Draw diagonals AC and BD. The point of intersection O will be the centre and OE the radius of the circle required.



20. *To circumscribe a square about a given circle*:

Find the centre of the circle.

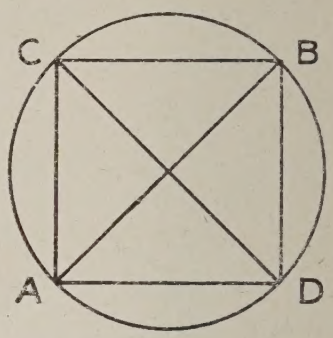
Through the centre draw diameters at right angles to each other. Through the ends of these diameters draw lines at right angles to them. The resulting figure is the square required.



21. *To inscribe a square in a given circle*:

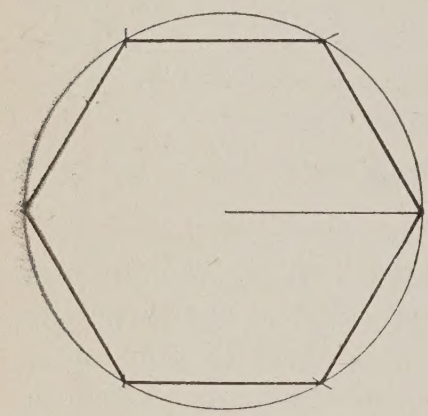
Draw any two diameters at right angles to each other. Join the ends of these diameters.

ACBD is the square required.



22. *To describe a circle about a given square*:

Draw diagonals AB and CD intersecting at O. With OB as radius describe the required circle.



23. *To inscribe a regular hexagon in a given circle.*

Find the centre of the circle and mark off the radius six times on the circumference.

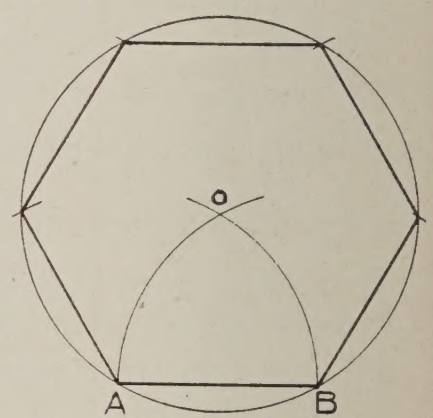
Join the points and the figure will be the required hexagon.

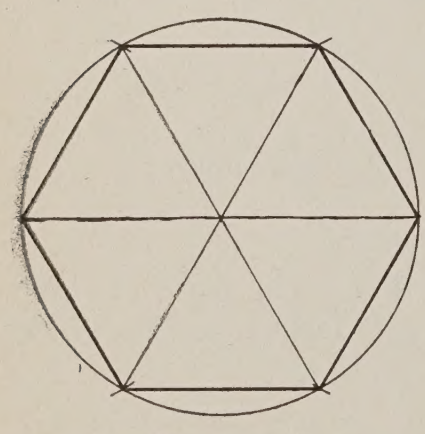
24. *To describe a regular hexagon on a given line AB.*

With A and B as centres and AB as radius, describe arcs intersecting in O.

O is the centre of the containing circle. With O as centre and OB as radius describe the circle and set off the radius six times on this circle.

Join the points and obtain the required hexagon.





25. This figure is composed of six equal triangles all equilateral and equiangular.

Thus all the lines are equal to each other and all the angles are also equal to each other.

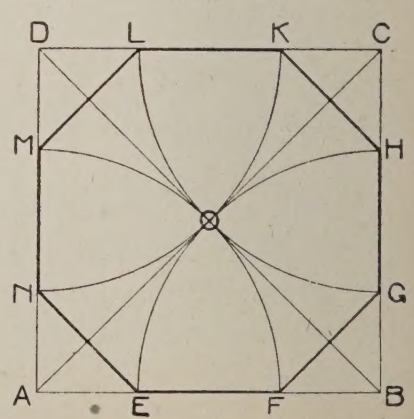
26. *To inscribe a regular octagon in a given square.*

Let ABCD be the given square.

Draw diagonals AC and BD intersecting in O.

From A, B, C, and D as centres and AO as radius describe the arcs FOM, EOH, GOL, and KON.

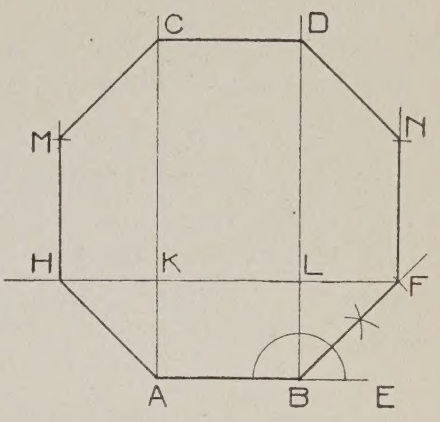
Join EN, ML, KH, and GF, and the required octagon will be obtained.



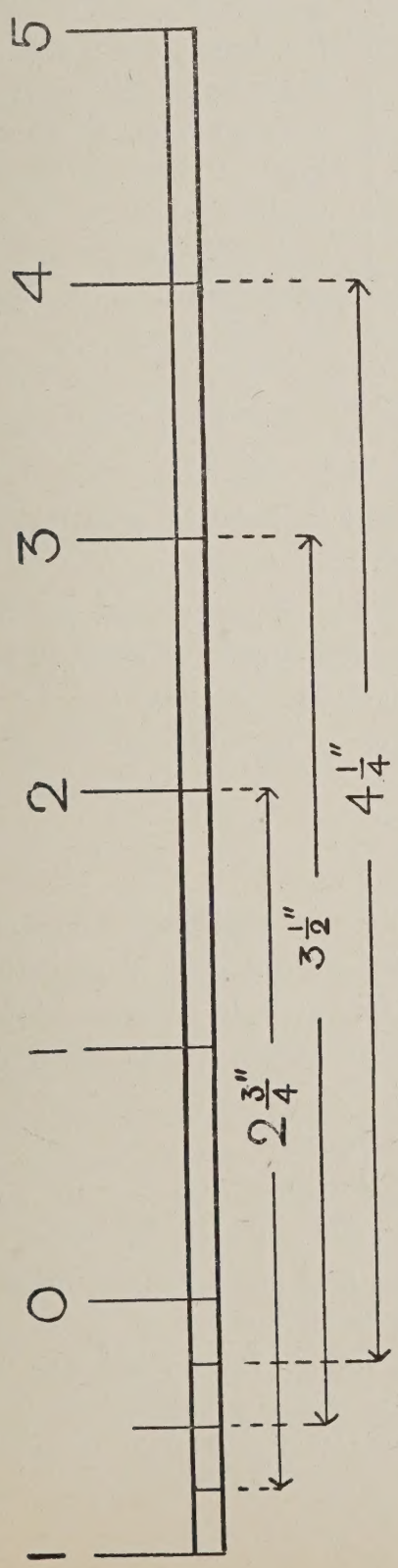
DEPT. OF EDUCATION
HISTORICAL COLLECTION

27. To describe a regular octagon on a given line AB.

Let AB be the given line.



At A and B erect perpendiculars AC and BD. Produce AB to E. Bisect the angle DBE by the line BF. Make BF equal to AB. From F draw the line FH parallel to AB and make KH equal to LF. Join AH. Set off on AC and BD, from the points A and B, a length equal to HF, and this will give the points C and D. With the points C, D, H, and F as centres, and a radius equal to AB, draw arcs intersecting at M and N. Join HM, MC, CD, DN, NF. This will give the required octagon.

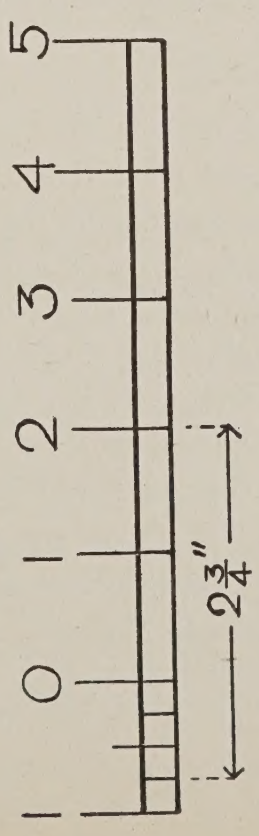


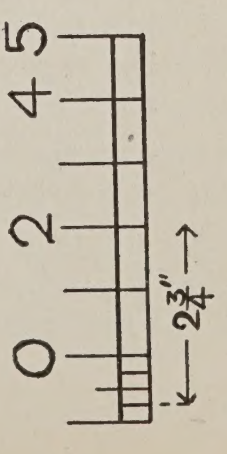
SCALE DRAWING

When large objects, buildings, etc., are to be represented on paper by drawings, it is obvious that the dimensions must be reduced proportionately in order that the details required may be reproduced on paper of convenient size. For this purpose we use a *scale*.

When the object is small enough it is drawn full size; the larger the object, the greater the reduction in the size of the drawing.

The scales to be used in this Form will be: Full Scale, Half Scale, and Quarter Scale.

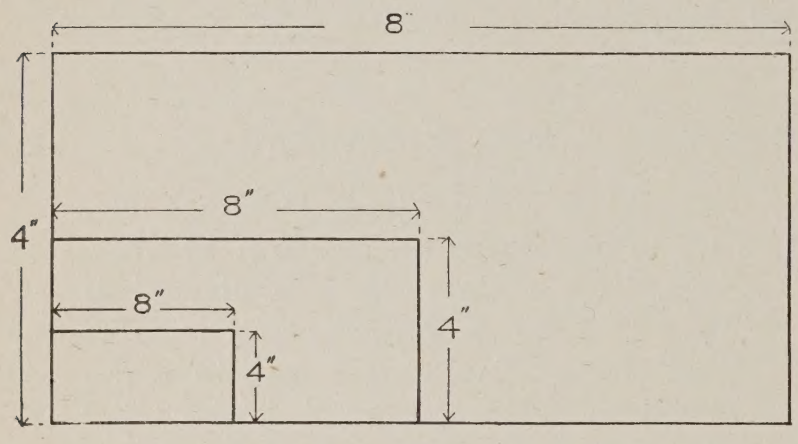




FULL SCALE:

Take some simple object, for example, a chalk box, and let the children measure one side only at this stage. Suppose the front of the box measures 4 in. x 8 in.

A pupil measures the lower edge of the box and finds it to be 8 in. All then draw lines 8 in. long near the lower edge of their papers. Another pupil measures the height and finds it to be 4 in. What kind of angles has the box? Right angles. Erect perpendiculars 4 in. long at each end of the line. Join the upper ends of these.



This gives a rectangle exactly the size of the side of the box chosen, and being a drawing of the front is called a Front View or Front Elevation. Print this in some convenient place. Draw dimension lines as shown and attach the figures 4 in. and 8 in. respectively.

HALF SCALE:

This means that every line in the drawing will be half the true length of the side which it represents; for example, a half inch to one inch.

How long is the lower edge of the box? 8 in. What should be the length of the line to represent this? 4 in. What dimension must we place to this line? 8 in. Why? Because it represents an object which is 8 in. long.

Deal with the vertical lines in the same way. Print title as before.

QUARTER SCALE:

Take the same object and treat it in the manner described for Half Scale. Every line drawn will be one quarter of the actual dimension. Print title.

Very small objects often require enlarged drawings to show their parts clearly. As an example, take some small object in paper which the pupils have made, and draw it to the following scales:

1 in. to ½ in., that is, twice the size of the object.

1 in. to ¼ in., that is, four times the size of the object.

Show the class how to construct and use a scale showing ¼ in.

Draw a line 6 in. long. Mark off the inches and erect perpendiculars ½ in. long at each division. Complete the scale as shown in the figure.

The division on the left is the only one subdivided. Find the half-inch mark in this and erect a perpendicular ⅜ in. long. Draw another 6-in. line ⅛ in. above the first one. Divide the first inch into quarters and erect perpendiculars.

To measure 3½ in. by means of this scale, measure from the figure 3 back to the ½-in. division.

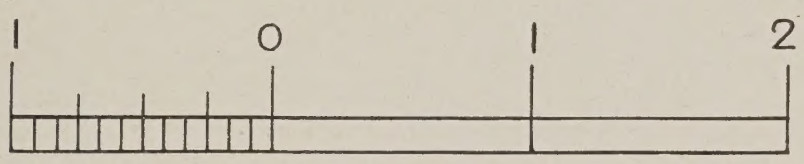
To measure 4¼ in. measure from the figure 4 back to the ¼-in. division, and so on.

We can use the above scale when drawing to the scale of $\frac{1}{12}$, or 1 inch to one foot. Each one-inch division will then represent one foot and will be so denominated. The divisions in the left-hand space wlll each represent ¼ ft. or 3 in.

3 ft. 9 in. will be represented by a line drawn from the figure 3 back to the third subdivision.

Work out an example to this scale of some large object ignoring dimensions less than 3 in.

At a future lesson divide the first space into twelve parts thus:



Each subdivision then represents 1 in.

Again the same scale may be used for still larger objects by considering each one-inch space as representing 1 yard, that is, a scale of $\frac{1}{36}$ or 1 in. to 1 yard. Each subdivision will then represent ¼ yard or 9 in.

To make a simpler scale for pupils of this age have 3 subdivisions substituted for 4. Each division will then represent 1 ft.

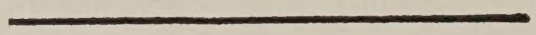
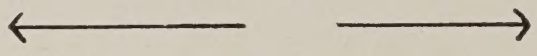
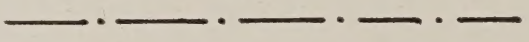
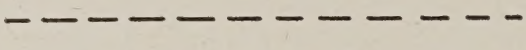
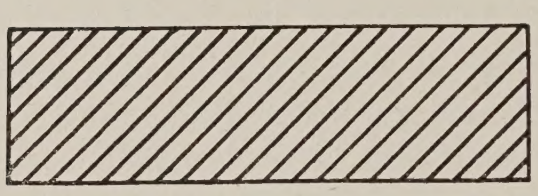
Make a plan of the room to the scale of 1 in. to 1 yard.

(Use three subdivisions and ignore measurements less than 1 foot.)

THE READING OF A DRAWING

In all mechanical drawings lines have a certain definite meaning. Just as in reading a book letters are used to form words, and these again to form sentences, so lines of different kinds are used in drawing to convey certain definite meanings. A draftsman, by the proper use and arrangements of his lines, enables a workman to read a drawing. In some of the more advanced forms of mechanical drawing, for example, in building construction, a man, when examining a properly drafted plan and elevation, can tell at a glance the different kinds of material to be used in different places in the building, as planned by the designer. Drawing is, therefore, the language by which the designer speaks to the workman.

In this manual, however, we are only dealing with the very simplest form, the very A B C, as it were, of drafting, and shall require but a few lines to express the meanings desired.

1. Heavy full lines.		To show the true shapes of all finished objects.
2. Heavy dotted lines.		To show unseen edges of such objects. They are also used for scored lines in cardboard work. Lighter dotted lines show projectors.
3. Fine full lines.		To show the construction by which shapes are obtained.
4. Long broken lines with arrow-heads.		To show dimensions.
5. Centre lines.		
6. Projector.		For carrying a point on one drawing to a corresponding point on a second drawing which is projected from the first.
7. Section lines.		Parallel lines, generally at an angle of about 45 degrees, to show sections or cut surfaces.

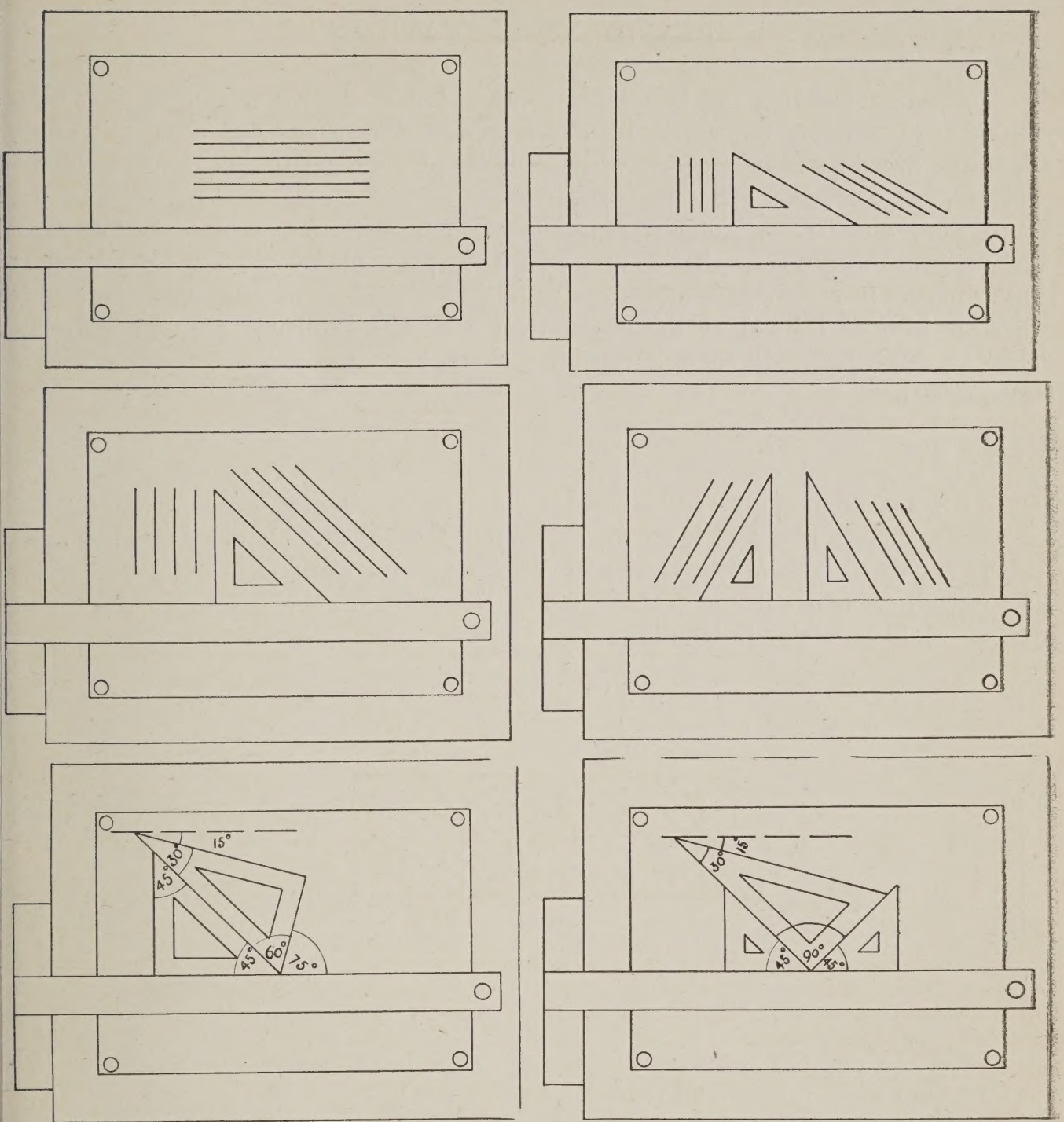
NOTE.—It is important that the arrow-heads in 4 should be placed at the very commencement and also at the termination of every length of line dimensioned. This will be obvious when we consider that we often require to show several measurements along one continuous line.

THE USE OF DRAWING-BOARDS, T-SQUARES, AND SET-SQUARES

The pupils should be taught the use of the drawing-board as early as possible, for by it, in conjunction with the T-square and set-squares (or triangles as they are often described), the work of mechanical drawing is much simplified.

After the pupils have learnt the geometrical construction necessary to enable them to draw lines at right angles to each other, and have had sufficient practice to fix that construction well in their minds, it is a waste of time and energy to employ it when many lines are to be drawn perpendicular to each other. These lines can be drawn quickly and accurately by means of the T-square and set-squares.

The drawing-board should have a good level surface, with its adjacent edges at right angles to each other.



The T-square derives its name from its shape, and must be used with the left hand, leaving the right hand free to draw the required lines. The cross bar or head of the T-square is always placed along the left-hand edge of the drawing-board, so that by sliding it along the edge, any number of horizontal parallel lines can be drawn.

The set-squares are placed against the edge of the T-square when in position on the drawing-board, and with these, vertical lines, and lines at various angles may be drawn. By sliding the set-squares along the edge of the T-square a large number of parallel lines can be drawn in these directions. If no T-square is available, the set-squares can be used against the edge of a straight flat ruler, but it is not likely to produce such accurate results as when they are placed against the edge of the T-square.

Place the paper on the drawing-board with one edge parallel to the edge of the T-square, and fasten with drawing pins. Draw lines in various directions and at various angles in order to acquire facility in the use of the instruments.

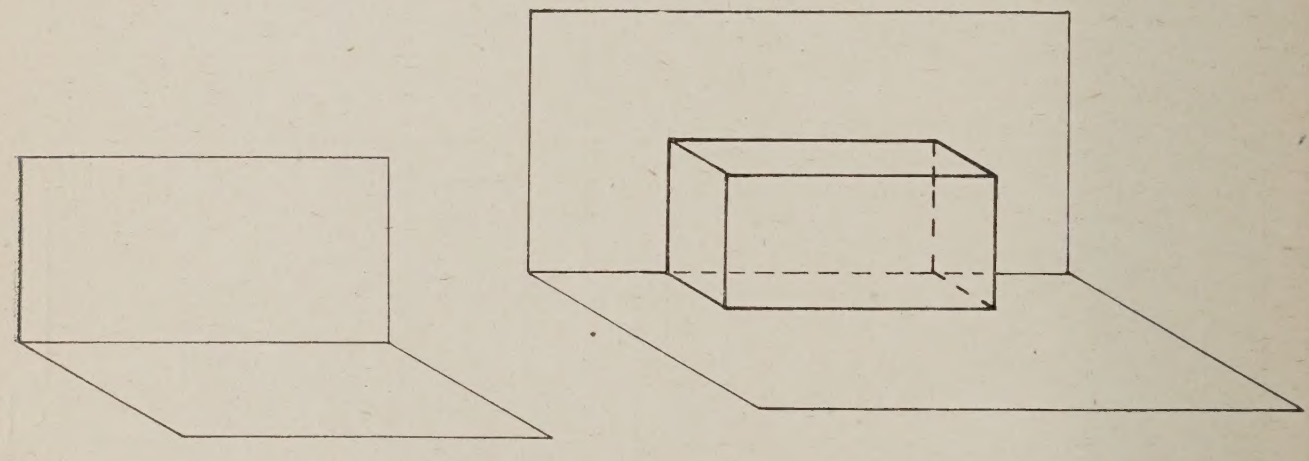
PLANS AND ELEVATIONS

Before a building can be erected or an object made, the workman must have a working drawing on which all the necessary dimensions are shown. These working drawings consist of two or more views of the object as seen from different points, and are called plans and elevations.

They differ from pictorial representations in that they show things as they actually are and not as they look. The basic principle of plan and elevation is not difficult to understand, and every endeavour should be made to give the pupils a clear idea of it, and of the geometrical problems involved. Thorough teaching at this stage will be well repaid. Some such method as the following is suggested:

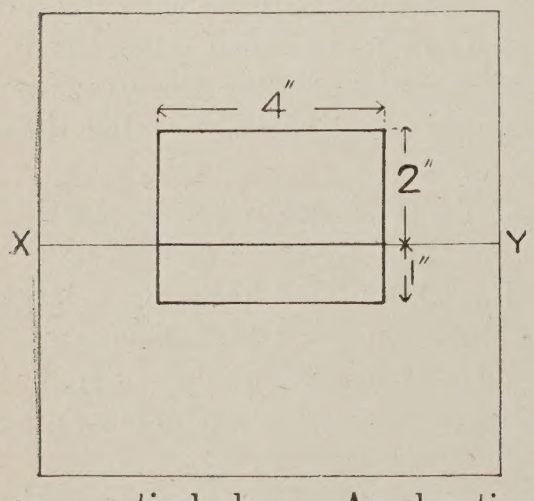
FIRST STEP:

Provide each pupil with a sheet of stout light-coloured paper at least 8 in. square and have him fold it on the horizontal diameter. This gives two planes at right angles to each other. From an 8-in. square of stout paper fold a checkerboard and from it cut and fold an oblong box 1 in. x 2 in. x 4 in. (Blocks of wood would be easier to handle.)



Let the pupils place this, on its 1-in. side, in the angle formed by the two planes and draw lines round it on both planes.

Remove the box and flatten out the paper on the desk.



The line XY shows where the two planes met.

This gives a plan and elevation of the box in the position mentioned. The two planes in this position correspond to the one plane represented by the drawing paper.

Let the pupils draw the figure. Carefully letter, and put in the dimensions.

The name *plan* is always given to the drawing of the object representing its position on the ground or when viewed from above. *Elevation* is the term used to denote a drawing on a vertical plane. An elevation always shows height.

In a similar manner deal with the box lying on the end, and also on the broad side.

SECOND STEP:

Fold the planes as in the first step.

Place the model in position as before.

Draw round the model on the vertical plane only.

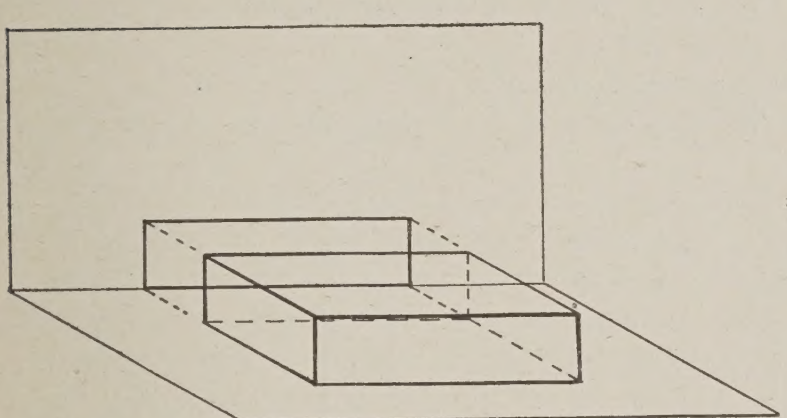
Fix the set-square with one square edge against the vertical plane and the other square edge against the model.

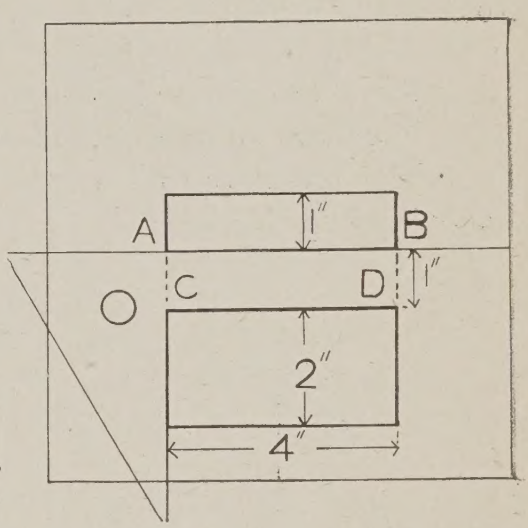
Now slide the model forward for 1 in. and draw round the model on the horizontal plane.

Swing the planes into one plane. Draw the figures, letter, and dimension.

Dot the lines AC and BD to show the direction which the sliding model took.

Note that AC and BD show the distance the model is from the vertical plane.





THIRD STEP:

Fold the vertical and horizontal planes.

Take a model similar to that used in the previous step. Place it against the vertical plane, but have it resting on an object about ¾ in. thick.

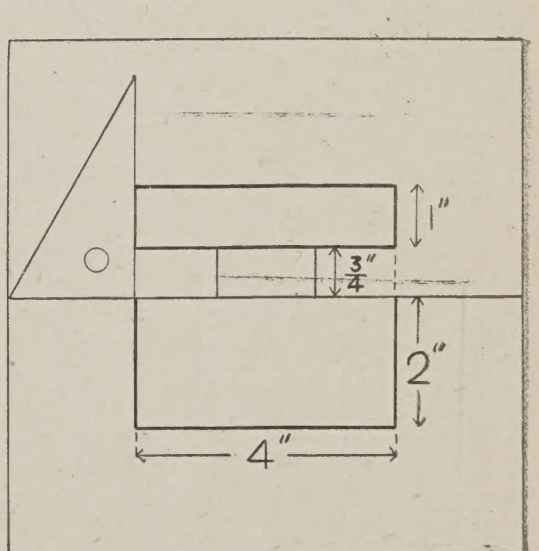
Draw round the model on the vertical plane.

Place the set-square against the model and the plane as before. Remove the support and slide the model to the horizontal plane.

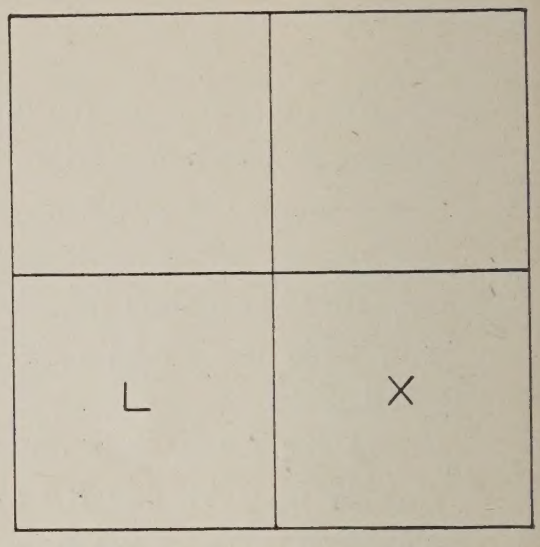
Draw round the model on this plane.

Draw the figures (omitting the support).

Letter and dimension as before.



FOURTH STEP:



Take a sheet of stout manilla paper at least 8 in. square. Fold vertical and horizontal diameters. Make a cut along half the vertical diameter. Fold X under L. This gives two vertical planes at right angles to each other and a horizontal plane at right angles to the vertical planes.

Take a model smaller, but similar to the one mentioned in the first lesson, and place it in the angle formed by the union of the three planes.

Swing the right-hand vertical plane back and draw round the model as in the first step.

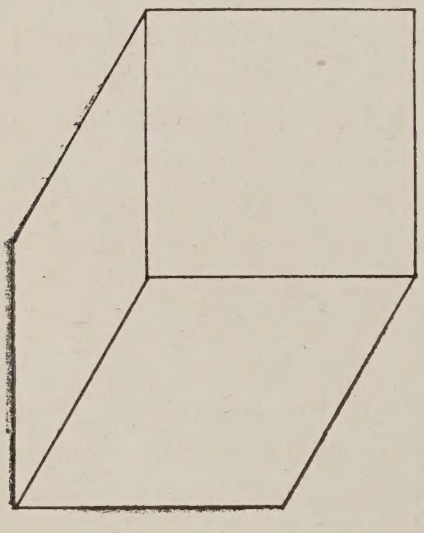
Now bring back the right-hand vertical plane to its proper position and draw round the model.

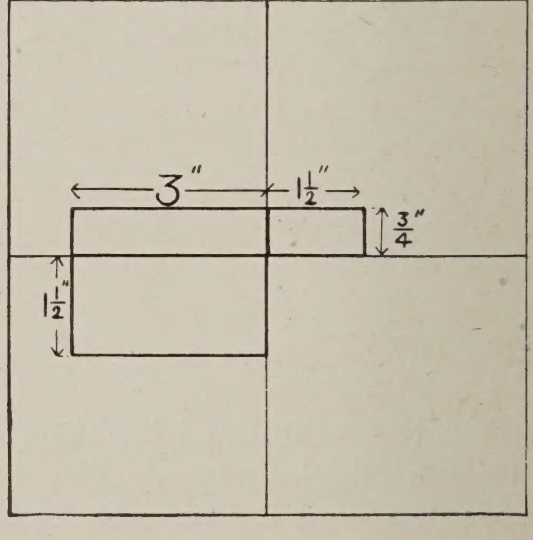
Swing the planes back so that they will all make one plane.

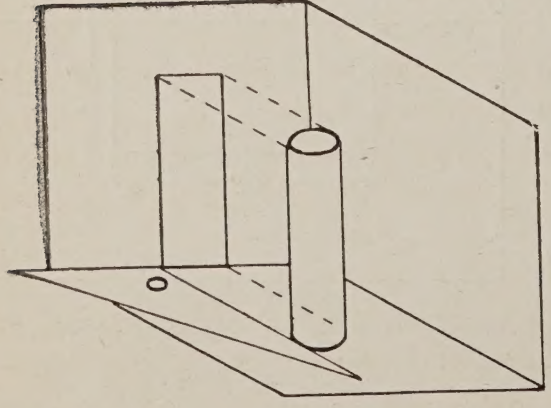
Copy this, and dimension as shown.

Treat the other positions in a similar manner.

The model can be moved forward or raised as described in Steps two and three.





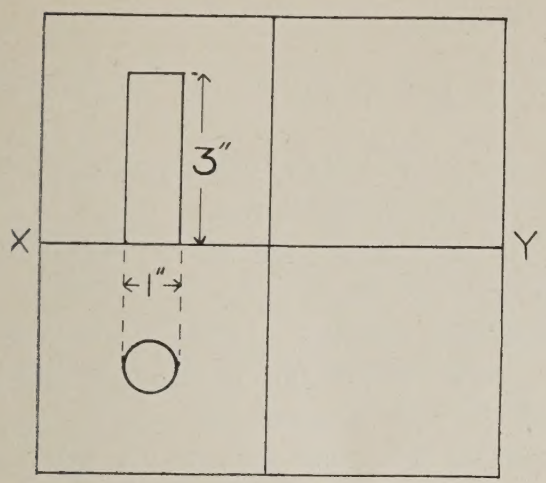


FIFTH STEP:

Fold the three planes.

Take a small cylinder 1 in. in diameter and 3 in. long. These can be made of stout paper or light cardboard, or small cylindrical boxes may be used.

Place the model on the horizontal plane on one of its ends. Draw round it as before for the plan.



Now take the set-square and lay it flat on the horizontal plane with one square edge against the vertical plane. Instead of sliding the model along the edge of the set-square as recommended in the previous steps, draw dotted lines (projectors) along the edge resting on the horizontal plane until it meets the vertical plane. Do the same with the other side of the model. From these points on XY draw vertical lines 3 in. high.

Or place a sheet of paper on the top of the model and touching the vertical plane. The edge of this sheet will show the position of the line on the vertical plane. This is probably the better method at this stage, as it will serve to demonstrate the fact that the upper surface is to be represented by a straight line. Join the points on XY by vertical lines to this line.

Show that all elevations of the cylinder are alike.

Swing the planes into one plane. Copy the drawing carefully.

LETTERING

Every working drawing should be carefully lettered, no script being allowed. Letters are of many types and their proportions vary, but all are governed by certain rules of form and construction. For the purpose of lettering working drawings, a simple style of alphabet is desirable. Probably one of the most suitable types admitting of modification of proportions for various purposes is the one given on Plate 37, p. 148.

The proportions of this type of letter are 2 to 3, that is, the width of each standard letter is two thirds the height. All but 3 letters are this standard width—M and W are one fourth wider and I is half as wide. To plan an alphabet of this type, draw a rectangle as wide as the letters are intended to be high. Divide this rectangle by horizontal lines into 3 equal parts. Set off on the upper line the width (two thirds the width of the rectangle) of each letter. leaving spaces between each about one third the width of the standard letter. Draw vertical lines through these points. A visiting card makes a good straight edge. A finely pointed pencil is necessary. Notice how the horizontal lines help in the formation of many of the letters. All construction lines should be very lightly drawn as they must not show when the work is completed. The letters should be sketched lightly within the planned spaces.

When they are correctly formed darken the lines with brush, pen, or pencil.

For an alphabet of small letters construct a rectangle as previously described. To this add an extra division to accommodate the downstrokes of g, j, p, q, and y.

The body of the letter will occupy the two central divisions of the rectangle.

In printing titles, plan your letters for the space they are intended to occupy. Practise first on a separate sheet.

The figures shown are each planned to occupy a square.

In planning alphabets the proportions here given are merely suggested, and any other proportions may be adopted. Indeed it is well to allow the pupils to make modifications and design alphabets for themselves.

WORK IN THIN WOOD

The various articles required for this work are given in the chapter on "Materials and Equipment."

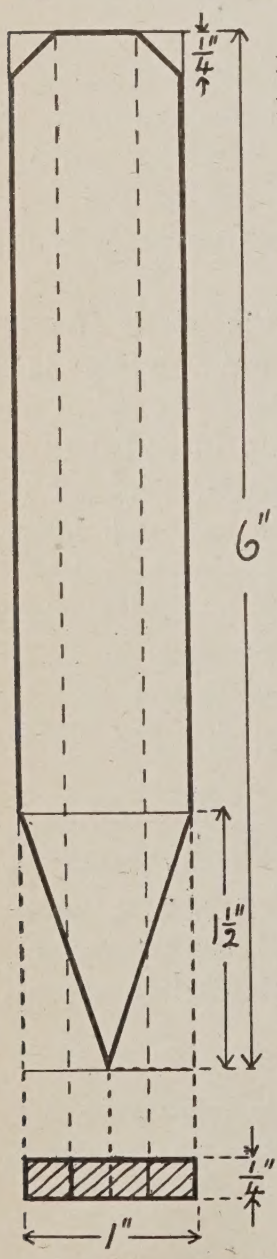
The models are intended to be suggestive both in design and character and should not be regarded as a prescribed course to be rigidly followed.

Before cutting with a knife the grain of the wood should be carefully examined. Cut with the grain, never against it.

The hand should never be placed in front of the cutting edge. In planning a course of work in this material the teacher should remember that the instructions here given are to enable him to understand the technique of the tool manipulations and to make the model before presentation to the class. These instructions are not an indication of the way in which he is to develop the lesson. Each lesson should be properly prepared and developed in such a way as to bring in all the correlated facts, and not treated merely as an exercise in making a pencil sharpener, a string winder, a plant label, etc.

It will be necessary to draw the model carefully before it is made. In the more simple cases, this drawing may be on the wood itself and the pupils allowed to work from a black-board drawing prepared by the teacher, or by themselves under his direction. In other cases a properly lettered and dimensioned working drawing should be made.

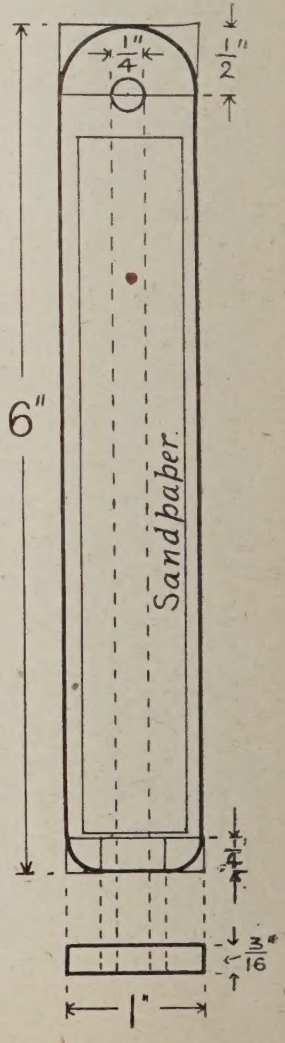
At other times the pupils should be allowed to take their own measurements from the prepared model and make their drawings from the measurements thus obtained.



1. Plant Label:

This is drawn in a rectangle 1 in. x 6 in. Complete the drawing as shown. Cut to width. Shape the point. Measure length from the point end. Set out shape of top as desired. Finish the cutting.

The drawing of these models provides the opportunity for carefully reviewing and extending what has been taught of plan and elevation.



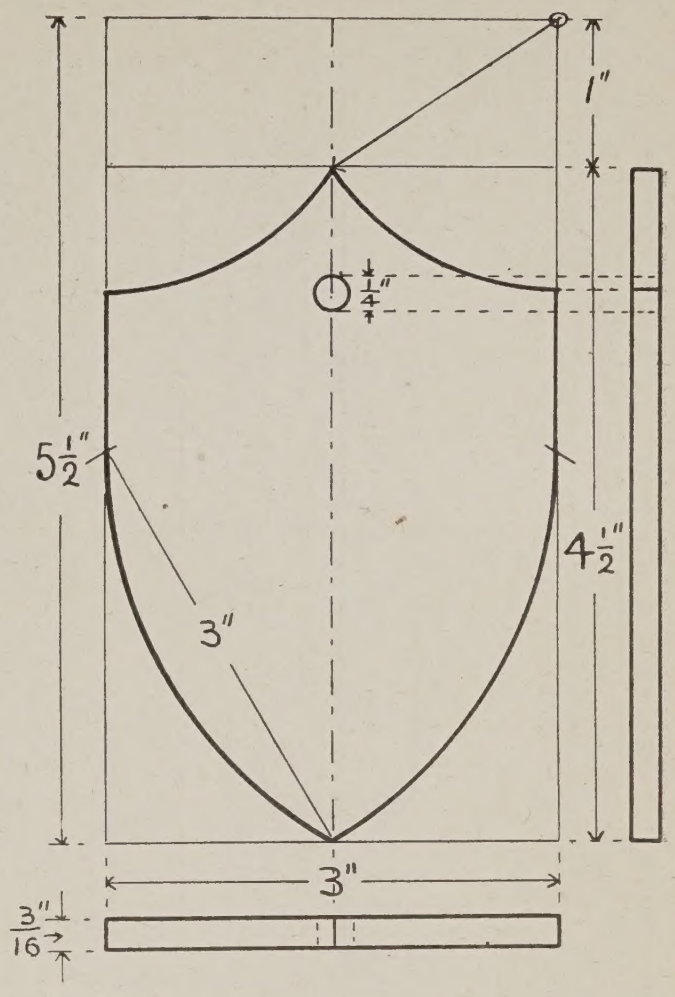
2. Pencil Sharpener:

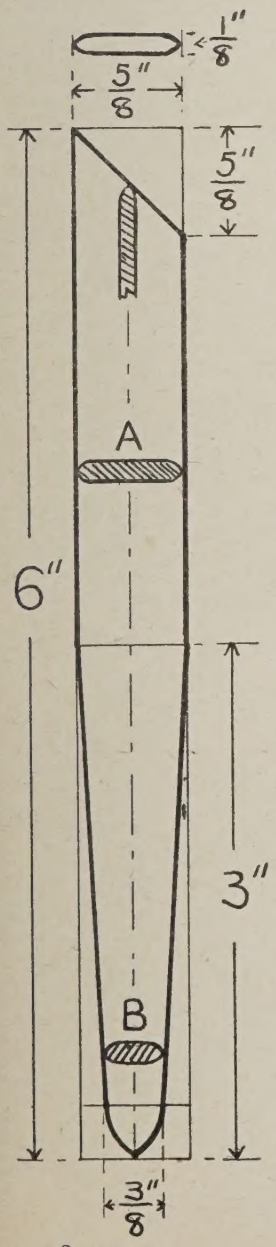
Proceed as in the previous model.

Ends of a different pattern may be designed. The sand-paper should be thinly glued, care being taken not to miss the edges. If sand-paper be glued on both sides of the model, warping will be largely prevented.

3. Match Scratcher or Calendar Rack:

This must be carefully drawn. Construct a rectangle 3 in. x 5½ in. Bisect the shorter sides and join the points. Describe the arcs with centres as shown. Cut to shape. The length of the model should be in the direction of the grain of the wood. If intended for use as a match scratcher, attach sand-paper.

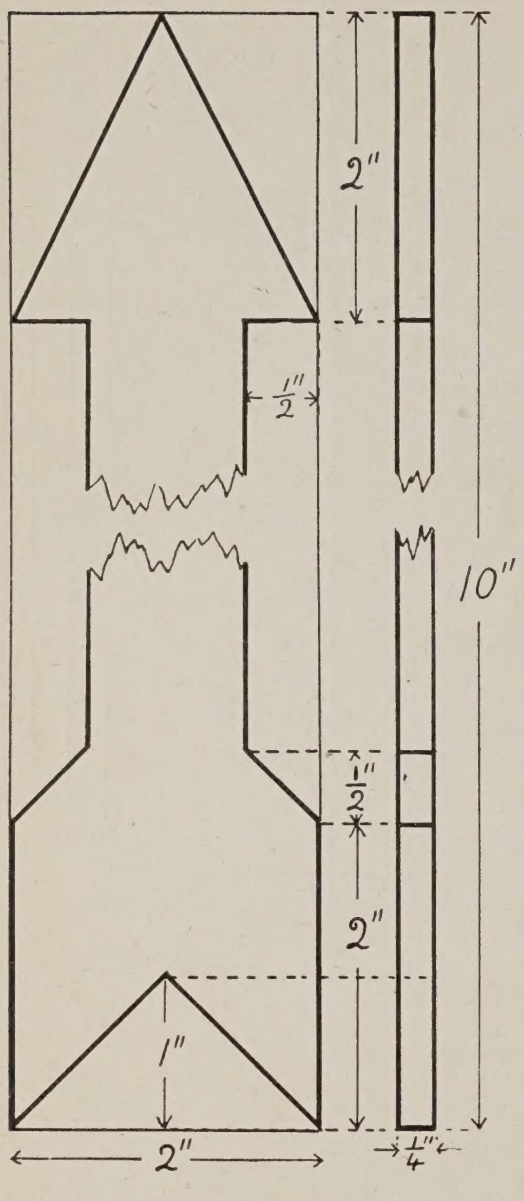




6 M.T.

4. Modelling Tool:

This is a suggested shape. After the model has been cut to shape, trim the back and front as shown by A and B. Paper knives or letter openers may be designed after the same fashion.



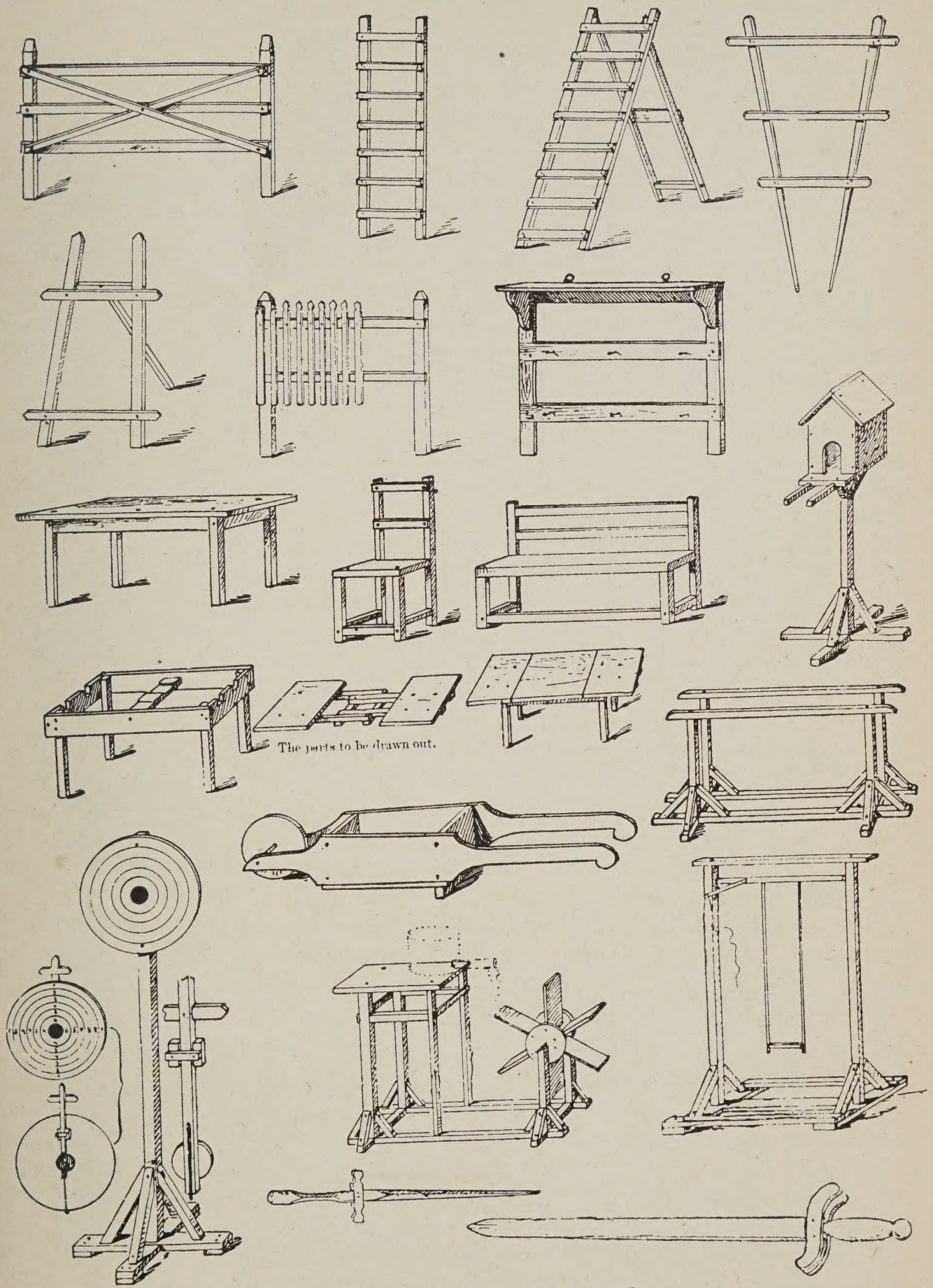
5. Arrow for Weather-vane:

Construct a rectangle 2 in. x 10 in. Complete the drawing according to measurements given.

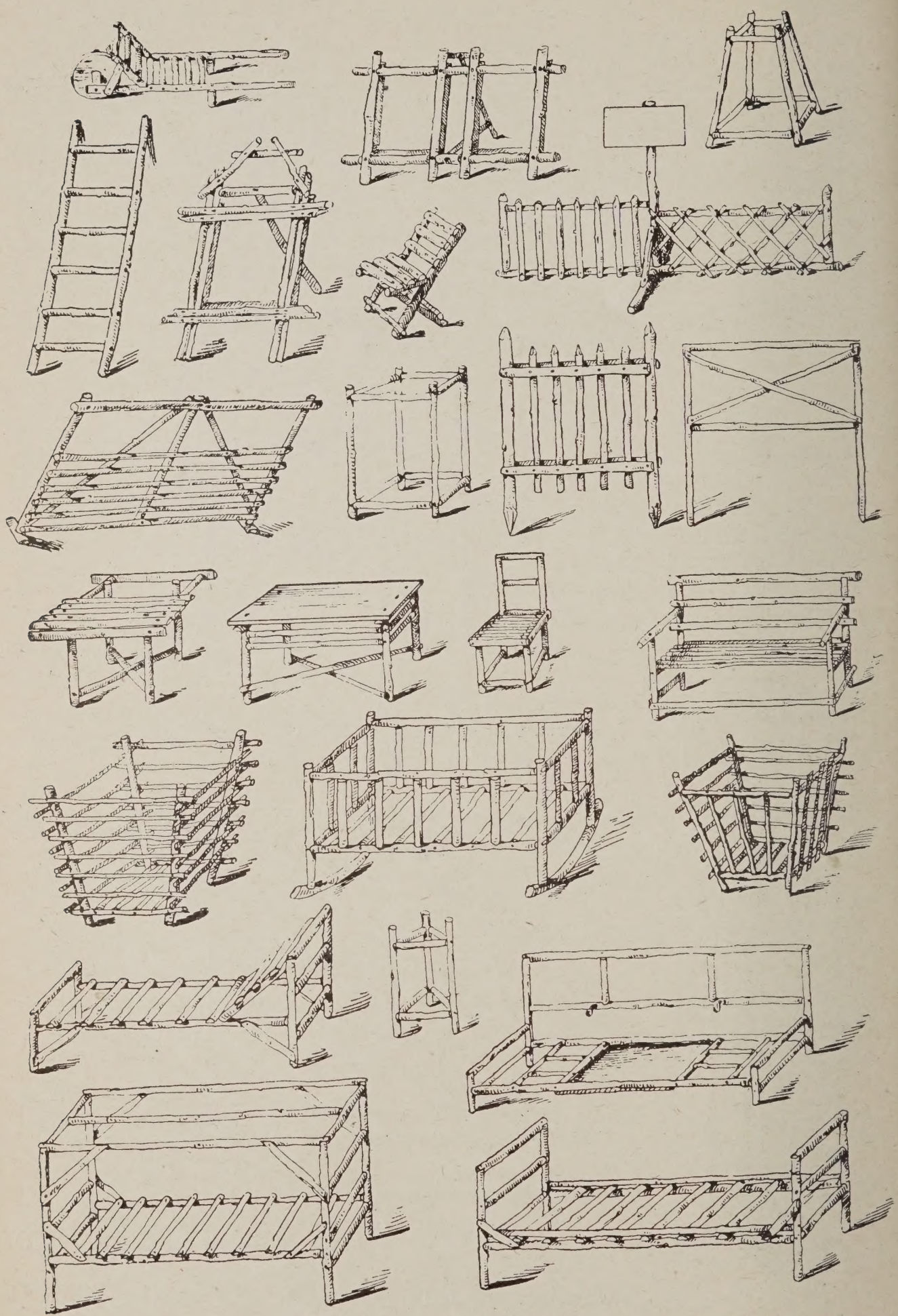
A coping-saw may be used with advantage in sawing out the various angles required. At this stage it is well for the pupils to saw slightly away from the line and trim back with the knife.

The above models each consist of one piece of wood. The teacher should now choose various articles such as boxes, letter racks, tie racks, post-card stands, brackets, and other objects consisting of two or more pieces. These are fastened together with glue and fine brads. In using the brad-awl be careful to cut across the grain in order that the wood may not be split.

The two following pages give illustrations of attractive objects which can be easily made by the pupil at this stage. The objects shown may be made of prepared slats or natural twigs which have been gathered and dried by the pupils. For this work the willow, the elder, the hazel, the pine, and various fruit trees yield suitable material. The twigs cut from trees and shrubs in the late autumn should be gathered and left to dry for this purpose.



Objects made from thin wood



Objects made from twigs

FORM IV

CLAY

MODELLING FROM NATURE:

If this subject has been taught systematically, the pupils will now be able to model natural objects with a fair degree of success. This will supplement nature study, since it is impossible to study well without close observation of the objects. In this way the salient features of types of plants can be well illustrated. Fruits, leaves, nuts, and some vegetables provide good exercises in modelling.

The average person imagines that he knows all about the characteristic features of the common objects around him, but on being called upon to represent these, he finds how little he knows; for example: the points of difference between the snout of a pig and that of a dog, the general form of the head of a dog compared with that of a sheep, or the form of the thigh of one animal compared with that of another.

MODELLING FROM CASTS:

Casts of portions of good ornaments may be modelled with advantage. From these, the pupils learn the methods of dealing with certain peculiar situations; the manner in which portions of a model must be treated (for example, the method of modelling the stalk of a leaf when raised some distance above the ground); the method, previously mentioned, of supporting thin objects.

The study of such ornamental work prepares the pupil to design and model patterns suitable for this particular material, and for the industrial purposes to which these may be applied.

Portions of the human figure such as hands in various positions, feet, eyes, ears, mouth, may be used as models before proceeding to work from the human figure itself.

Modelled heads of animals or human beings in various degrees of relief—high, low, or medium—make very good ornaments.

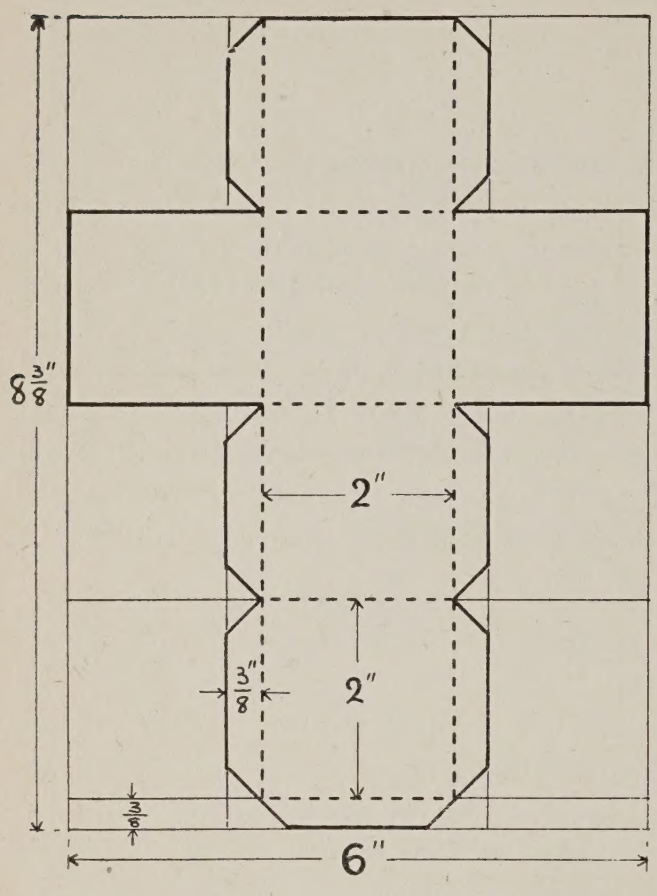
DESIGN:

There is great scope for this in modelling. In the modelling of tiles for various purposes, design has already been suggested in the preceding Forms. This may now be considerably extended both in character, detail, and purpose.

The pottery of Form III lends itself to the application of design in various ways. The general lines of the model itself, the shapes of handles and spouts and bases should all be considered in their relation to each other. Additional ornament may be obtained by incised patterns or by modelled overlay work. A study of the pottery in many of the better stores will suggest ideas for the treatment of this branch of modelling. Many good examples of design for particular purposes may be seen in the staff plaster work in our chief buildings. In museums, copies of choice examples of plaster pilasters and historic ornaments may be seen and studied with advantage. Photographs of the above may be worked from with good results.

The principles underlying designing are as applicable to clay work as to any other form of art and should be carefully studied.

CARDBOARD CONSTRUCTION



1. Cube:

This figure is included in a rectangle 6 in. x 8 in. which is divided into 12 squares with an addition of 3/8 in. to the length for a pasting flap. Complete drawing as shown.

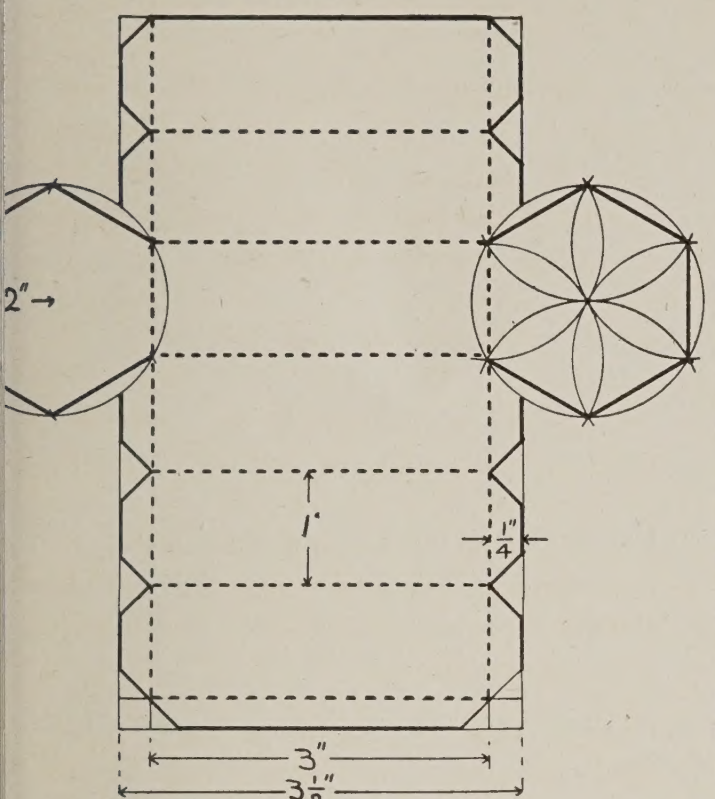
Lesson on the Cube

Each pupil should be provided with a cube and be led to discover the number of its faces and edges, the shape of the faces, and the length of the edges. At this stage the pupils should be able to make the drawing without assistance.

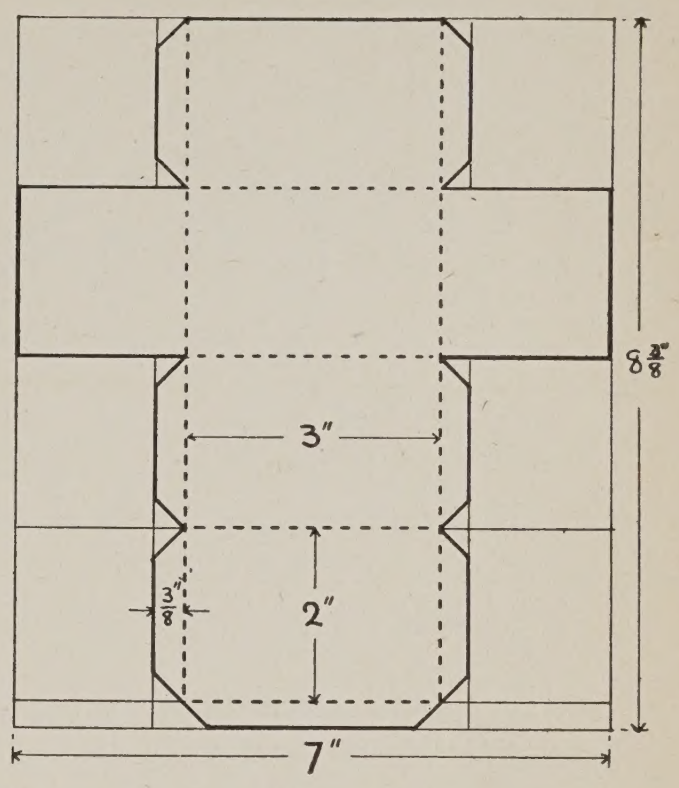
What kind of figure is each face? Find its area. How many inch cubes could you place in the model? What is the difference between two cubic inches and a two-inch cube? The edges of a cube are four inches in length; how many square inches are there in each face? What is the total area of the surface of the cube? How many cubic inches would such a cube contain? The edges of a cube are twelve inches. What is the area of each face? A wooden two-inch cube weighs one-half pound. What would a six-inch cube weigh if made of the same material? Draw the flat of a cube having an edge three feet to the scale of one inch to one foot.

2. Square Prism, and other Type Solids:

Drawings are shown of the Square Prism; Hexagonal Prism; Square Pyramid; Cylinder; Cone.

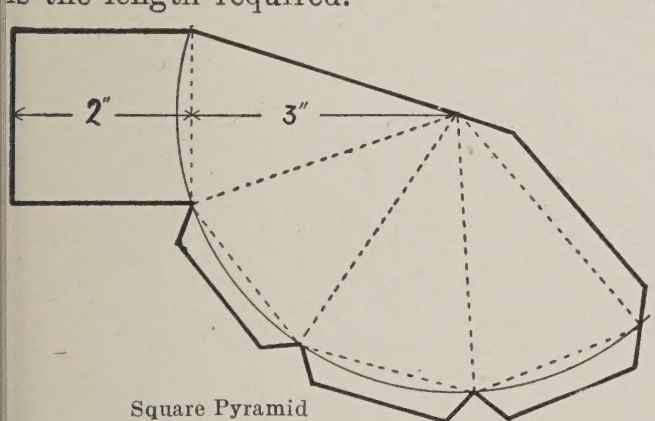


Hexagonal Prism



Square Prism

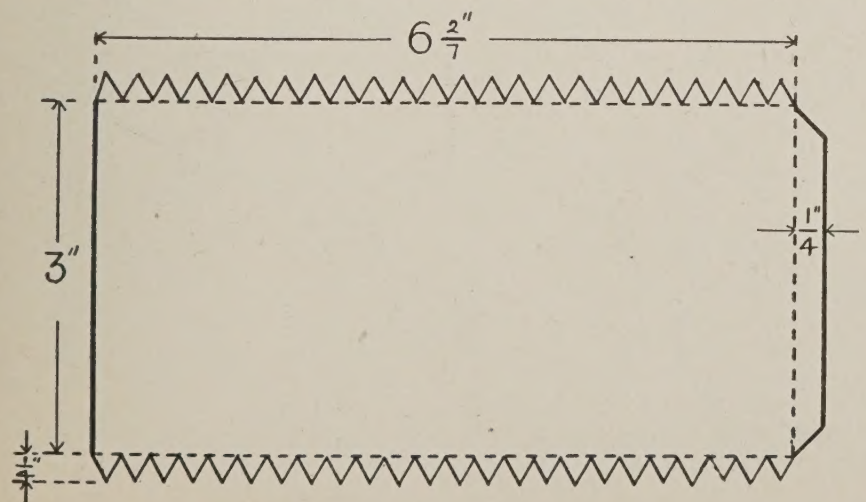
In the "stretch out" of the cylinder the length of the side of the rectangle will be $3\frac{1}{7}$ times the diameter of the end. This may be obtained by measurement. The diameter of the end is 2 in., therefore 2 in. by $3\frac{1}{7} = 6\frac{2}{7}$ in., which is the length required.

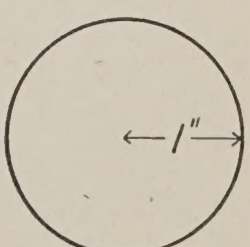


Square Pyramid

To obtain $\frac{2}{7}$ of an inch divide a one-inch line into 7 equal parts (Prolem 8, Form III, p. 67), and take 2 of them.

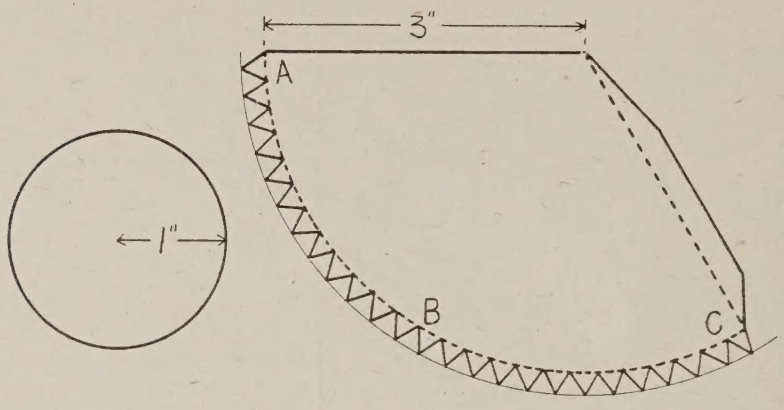
A mechanical method of obtaining the length of the rectangle is to cut out the two circles for the ends and measure the circumference of one of them by wrapping a strip of paper around it. The distance marked on this strip gives the length of the rectangle. Add a pasting flap.





Cylinder

The geometrical construction of the cone will be easily seen from the drawings.



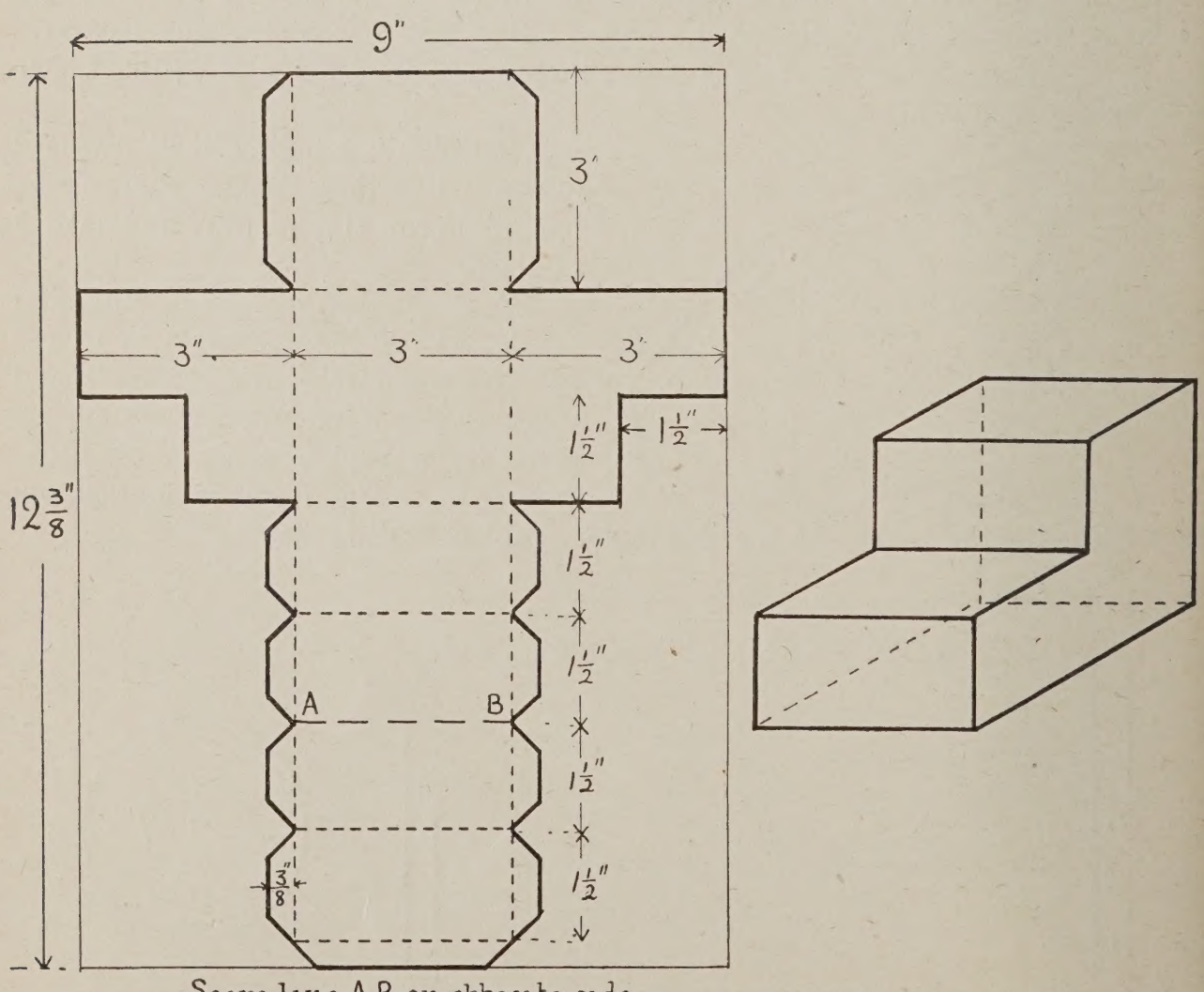
Cone

In the cone the arc ABC is equal to the circumference of the circle.

3. STEPS:

These are shown drawn in two ways; the "stretch cut," and a view of the completed object in what is called isometric projection.

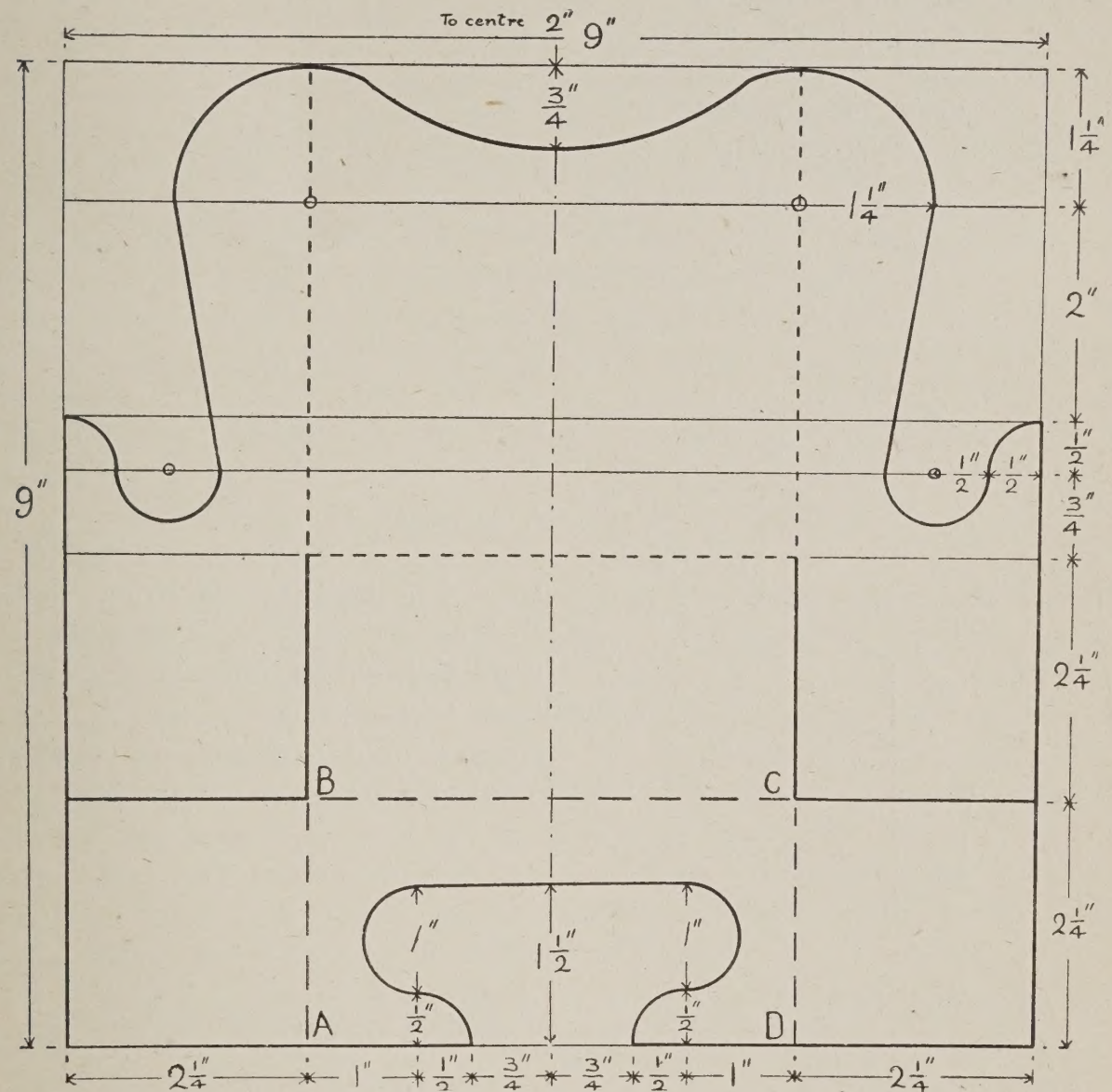
Note that the line AB is scored on the side opposite to the other scored lines.



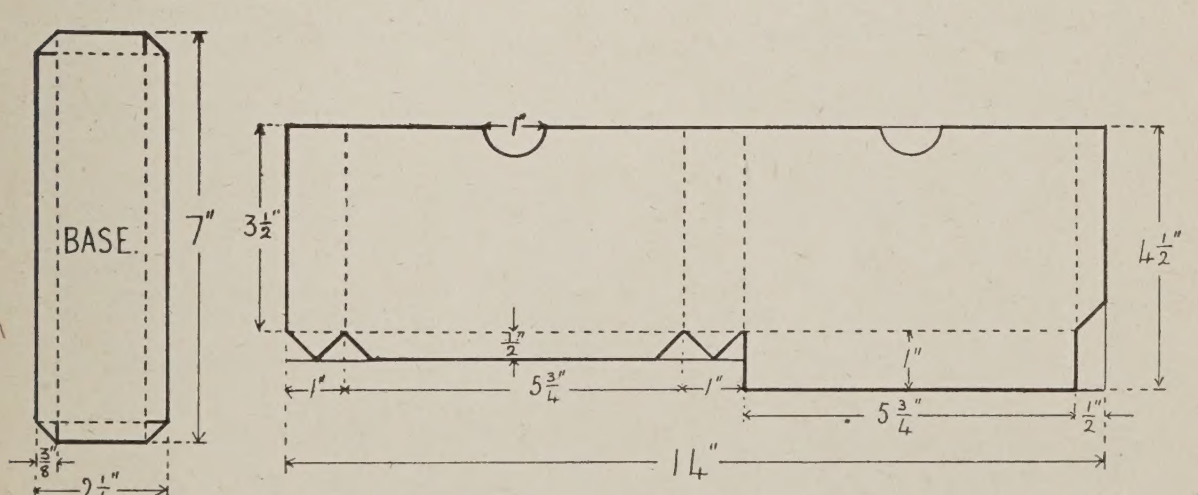
Score line A B. on opposite side.

4. SETTLE:

This drawing must be made carefully. The curves may be produced, by the aid of compasses, from centres as shown, or they may be drawn freehand. Lines AB, BC, and CD are scored on the opposite side.

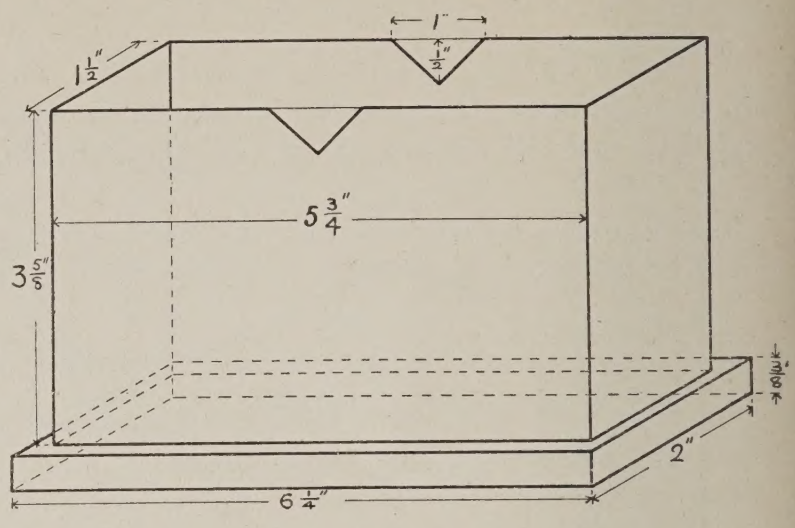


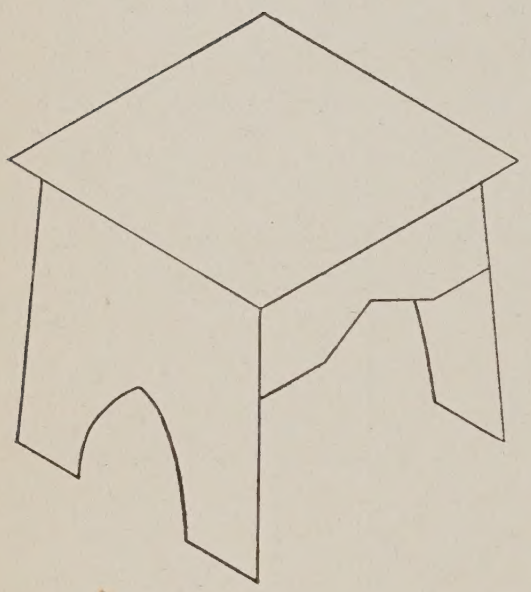
5. POST-CARD BOX:



This is drawn in a rectangle 4½ in. x 14 in. The base consists of a shallow inverted tray drawn in a rectangle 2¼ in. x 7 in.

This drawing shows a similar box completed, but with the cut-out portions triangular instead of circular, and different measurements.

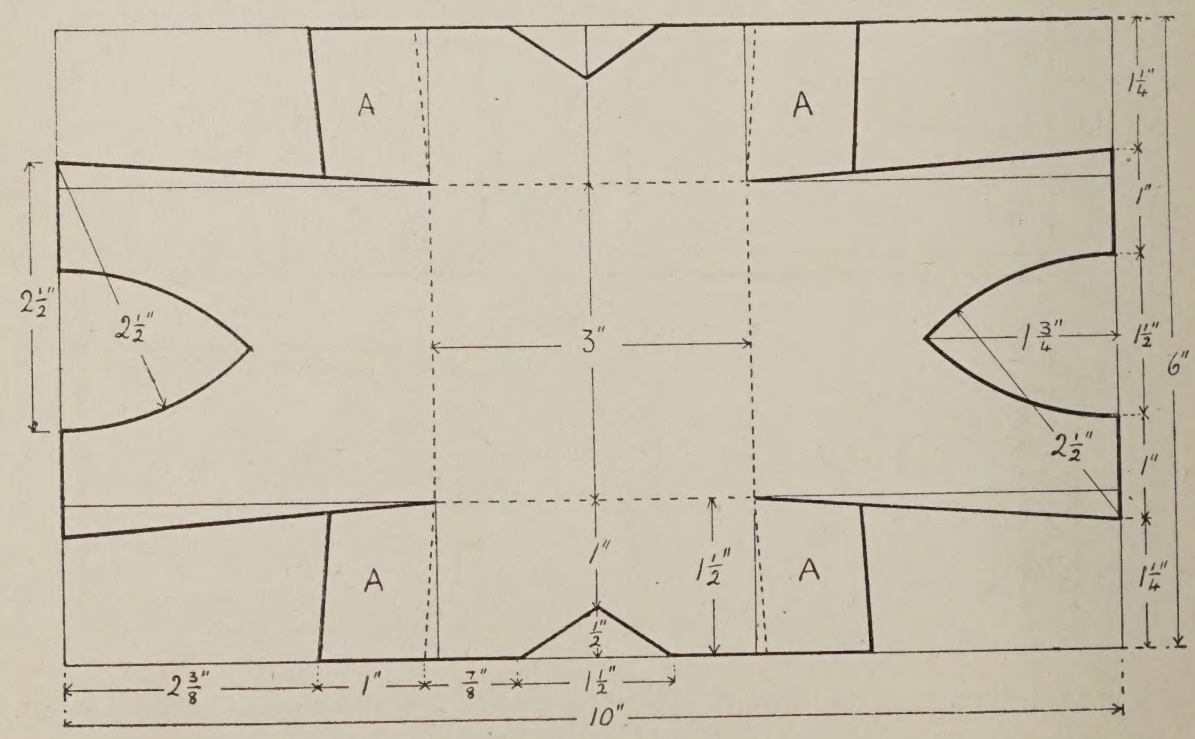




6. TABOURET:

Draw a rectangle 6 in. x 10 in. Complete the drawing according to dimensions shown. The pupil will find no difficulty if all measurements are accurately taken.

After cutting to shape and scoring, the flaps marked A are pasted to the legs.



7. Covering:

Many models are very much improved by being covered with fancy paper. The pattern of these papers should be carefully chosen. Some end papers used by bookbinders are very suitable for this covering. Paper with a small pattern should always be chosen. For a first exercise in covering, take a small square of cardboard (4 in. x 4 in.). Cut a square of the covering paper (5 in. x 5 in.). Place it on the desk, pattern downwards, with the cardboard in the centre. Fold the paper over sharply to the edges of the cardboard. Open out and note the creases. Cut corners as shown in the Folio (page 92). Paste the paper. Place the cardboard in position as before and rub down. Examine for air bubbles, fold edges over, and complete rubbing down. (Use a sheet of clean paper over the model whilst rubbing in order to prevent the paper from stretching).

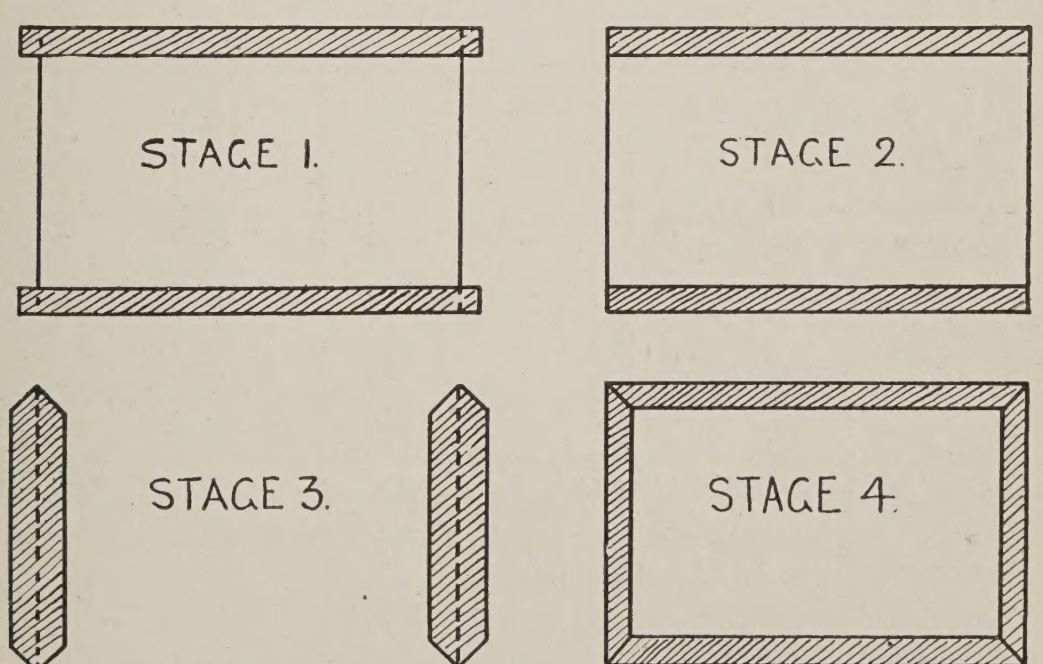
Cut another square of fancy paper ¼ in. smaller than the cardboard. This will leave a margin of ⅛ in. all round. Paste and place in position. Rub down as before.

Such mats may be used for calendar or picture mounts, and various other purposes.

8. Binding:

Before actually binding the edges of a model, a little preliminary practice is required. A suitable object for this purpose is a piece of cardboard intended to be used as a picture mount. Binding strips should be half an inch wide and may be purchased, or cut from coloured paper or bookbinders' cloth.

Suppose the cardboard be rectangular; cut two strips slightly longer than the long sides of the cardboard and two exactly the length of the short sides. Fold the strips lengthwise down the centre. Open out and paste. Place the edge of the cardboard in the crease formed by the folding. Press into position as shown in Stage 1. Trim as shown in Stage 2. Mitre as shown in Stage 3. Try them in position and, if they fit, paste and apply as in Stage 4.

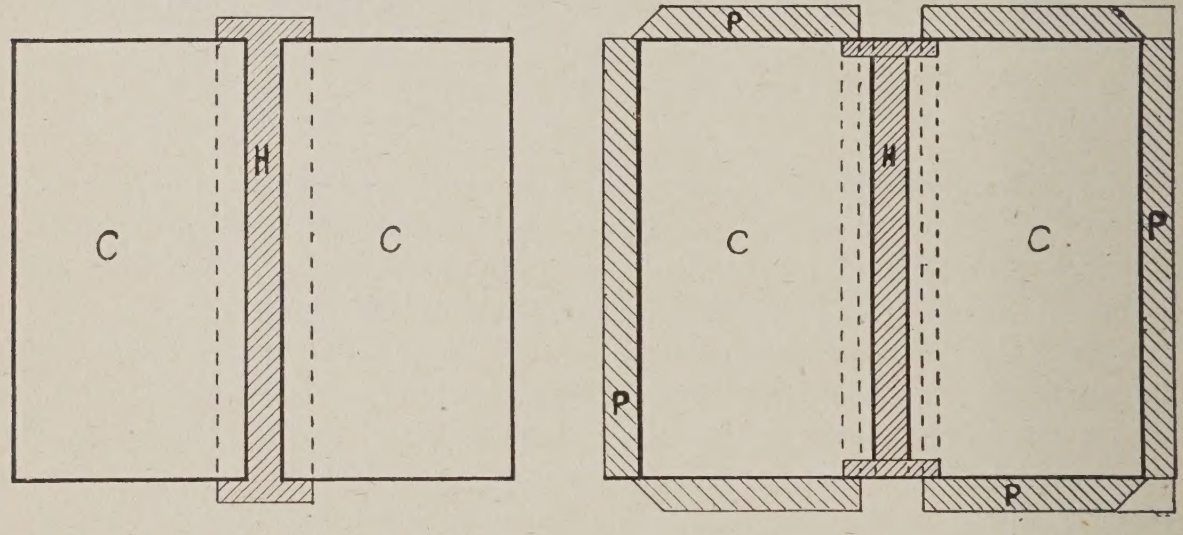


When a model is to be both bound and covered, the binding should be done first and the covering applied so as to leave not more than ⅛ in. of the binding showing.

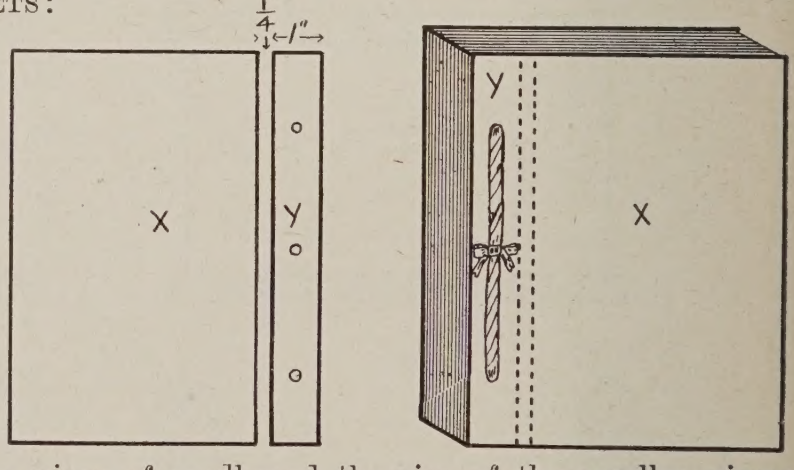
9. Book Covers and Portfolios:

Book covers may be made in every form, varying only in difficulty of execution and perfection of decoration.

The following is a description of the Figure. C and C are two pieces of cardboard of the size required. H is a strip of bookbinders' cloth, linen, or buckram, to form a hinge. P in the second figure represents the material with which the outside of the folio is covered. It is shown in position ready for folding over the edges. The inside of the hinge should be covered with a strip of cloth of the same width as the outside but ¼ in. shorter than the length of the cardboard. Be careful to press the two pieces of cloth forming the hinge well together and rub along the inside edges of the cardboard with the thumb nail or a bone folder. The inside of each board may be covered with any suitable material of a size sufficient to leave ⅛ in. margin on three sides. A portfolio with a flap is formed by adding a piece of cardboard to the free edge of C, making another hinge as at H. This flap should be about half the width of C.



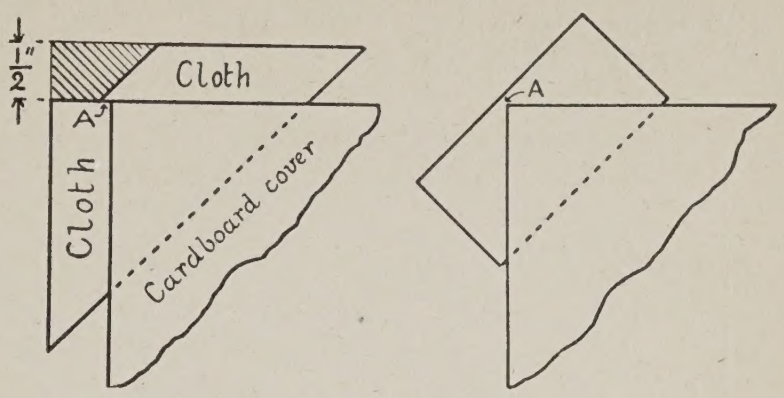
10. Cover for Loose Sheets:



This is a modification of the previous exercise. It consists of four pieces of cardboard (two of which are shown) hinged together in pairs by the method before described. Three holes are punched. The leaves to be fastened together are punched in corresponding positions. If a piece of cardboard the size of the smaller pieces be punched in the same manner, it may afterwards be used as a templet to ensure that all future holes be in the same position.

By pasting cloth of sufficient width for a hinge as shown in the folio, these books may be used for containing photographs, the mounts of which are punched to correspond with the holes in the covers. The whole is then laced together and fresh photographs can be inserted when required. The holes may be strengthened by the insertion of eyelets.

11. Corner Pieces:



It is often necessary in making folios to strengthen the corners with leather or cloth. This is done in the following manner:

From a square of cloth (say 3 in.), cut along the diagonal. This will give two corners. Paste the cloth and place in the position shown in the drawing. Cut out the shaded portion. Fold over, mitred corner last, and be careful to make close contact between the cloth and the edge of the board.

Another method is to take a rectangular piece of the material used, paste, and place in position as shown in the second drawing. Fold sharply over, and see that the edges of the material meet on the inside of the cover. Note space A which is equal to the thickness of the cardboard.

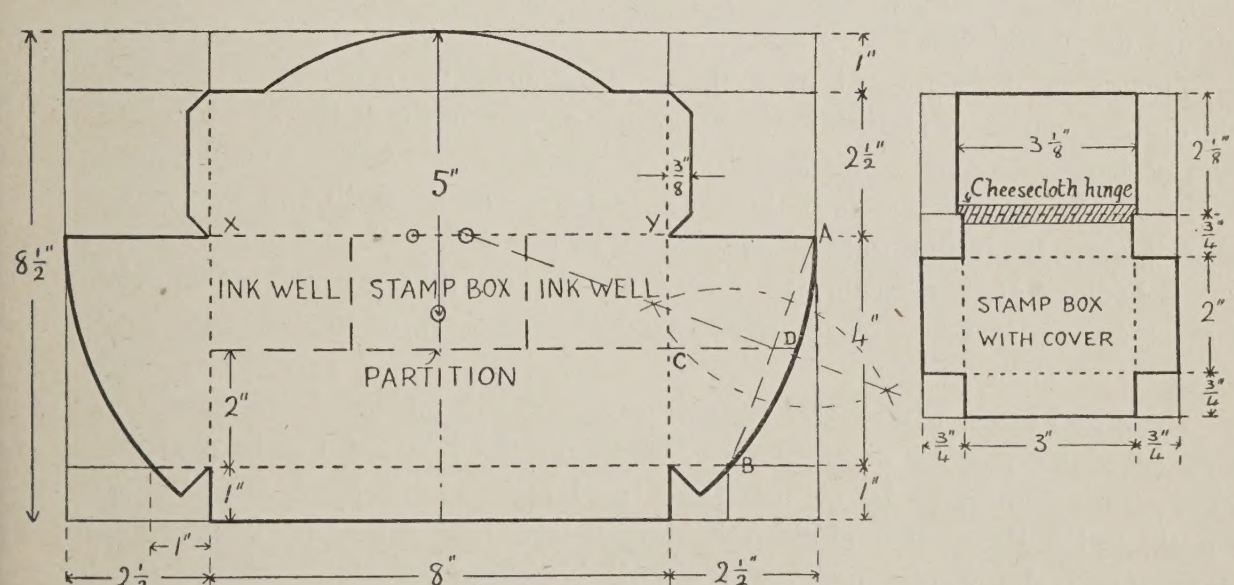
12. Pen and Ink Tray:

Construct a rectangle 8½ in. x 13 in. On each end set off distances 1 in.; 2 in.; 2 in.; 2½ in.; and joint these points by light lines. On the base line set off distances of 2½ in.; 4 in.; 4 in.; and from these erect perpendiculars.

The curves of the back and sides may be designed by the pupils. The centres of those given are shown.

The height of the partition is determined by the length of CD. It may be fixed in position by narrow strips of linen or cloth glued into each angle.

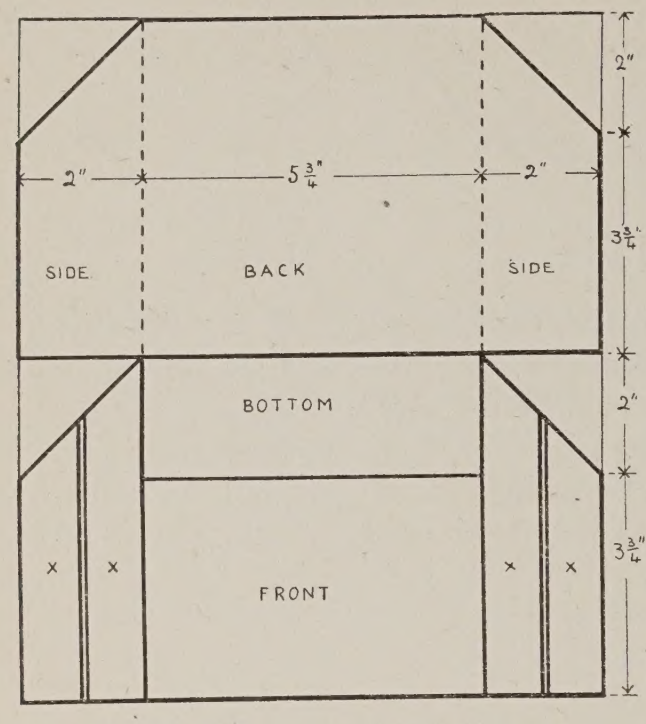
The corners of the stamp box should be glued together by strips of linen. The whole model is considerably improved by being bound and covered.

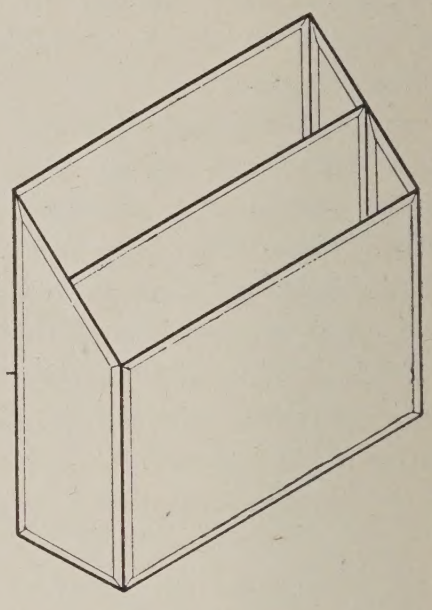


13. Stationery Box:

Construct a rectangle 9¾ in. x 11½ in. Complete the drawing as shown. The pieces marked X are glued to the sides to form a groove for the centre partition.

The picture of this model gives its appearance when bound with strips of cloth. After binding it may be covered if desired.





SIMPLE REPAIRS TO DAMAGED BOOKS

The life of many books can be prolonged through a little timely attention. Loose leaves should be carefully trimmed along the front edge and have the back pasted for 1/8 in. along its length using a paper guard to prevent the paste spreading. The pasted leaf should be carefully inserted in position and the book closed until dry. Torn leaves may be mended by pasting gummed strips of transparent paper on each side of the tear, care being taken to bring the torn edges as close together as possible.

The cover of a book that is badly torn may be repaired by covering with bookbinders' cloth as shown in the making of portfolios. If the old cloth can be stripped before this is done, it will be an advantage. After covering in this way take two sheets of paper, fold down the centre, and trim to the size of the leaves of the book. Paste one half of each sheet to the inside of each cover.

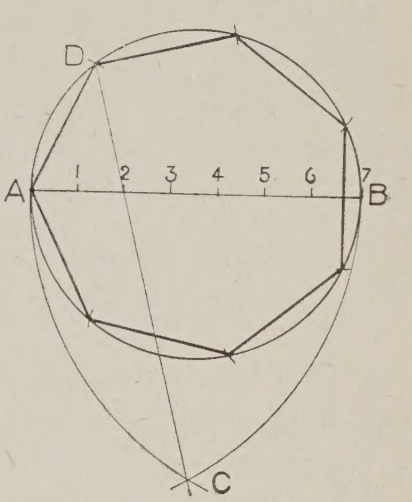
A book that has fallen to pieces should be taken carefully apart and restitched either on tapes or on cords as described in the reference books on bookbinding.

In those cases where the stitching remains intact and the back has fallen away, carefully paste a strip of cheesecloth on the back of the book, rubbing well down. This should be 1/4 in. less than the length of the book, thus leaving 1/8 in. at each end. Paste this cloth and replace the original cloth back rubbing well down. Over the whole, paste a piece of bookbinders' cloth sufficiently large to extend at least 1 in. over each board.

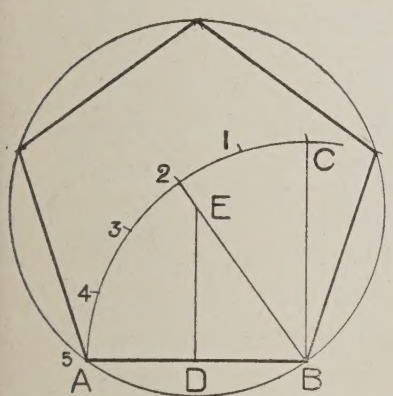
MECHANICAL DRAWING

Geometrical Problems

To inscribe any regular polygon in a circle:



General Method: Draw the diameter AB and divide it into as many parts as the required figure has sides—in this case, seven. With A as centre and AB as radius describe an arc BC, then with B as centre and with same radius describe another arc intersecting the former at C. From C draw a line through the second division until it meets the circumference of the circle at D; then AD is one side of the polygon. Mark off the remaining sides round the circumference. This will give the figure required.

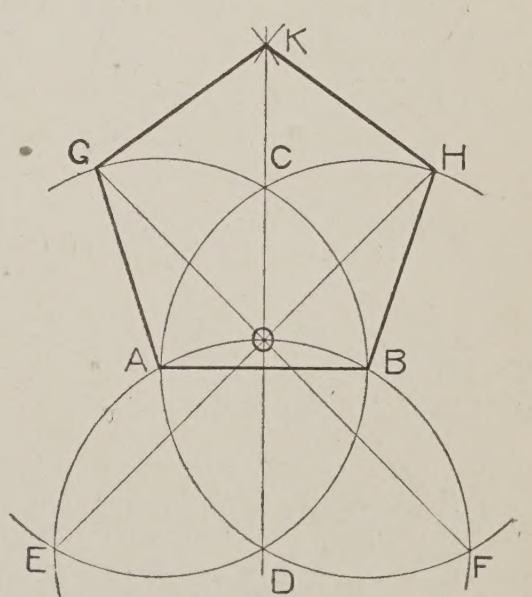


To describe any regular polygon on a given line:

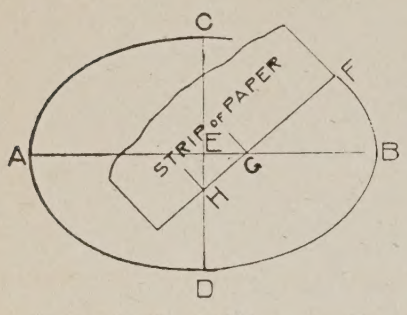
General Method: Let AB be the given line. At B erect a perpendicular BC equal to AB. With B as centre and BA as radius describe an arc AC. Divide this arc into as many equal parts as the required polygon is to have sides—in this case, five. Draw a line from B to the second division. Bisect AB in D and from D erect a perpendicular to cut B2 in E. From centre E with radius EB describe a circle. Mark off distance AB around it, join the points, and the required polygon is described.

Note: In both these problems the line is always drawn to the second division however many sides the polygon may have.

To describe a regular pentagon on a given side AB:



Special Method: With A as centre and AB as radius, describe circle CBDE, and with B as centre and same radius describe circle CADF; with D as centre and same radius describe arc EABF; join DC intersecting arc EABF at O. Through O draw lines FOG and EOH. Join AG and BH. With G and H as centres and AB as radius describe arcs intersecting at K. Join GK and HK. ABHKG will be the required pentagon.

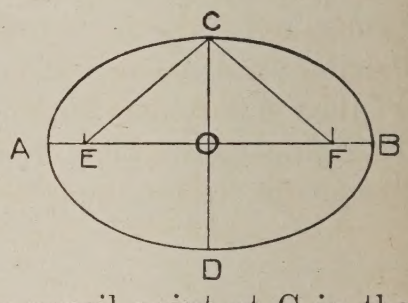


To construct an ellipse, the two axes AB and CD being given: (By the method of trammelling)

Take a strip of paper and set off upon it the distance FH equal to half the major axis, and the distance FG equal to half the minor axis.

By keeping the point G on the major axis and the point H on the minor axis, the point F will give a point of the ellipse. In this manner a succession of points is found. A curve drawn through these points will give the required ellipse.

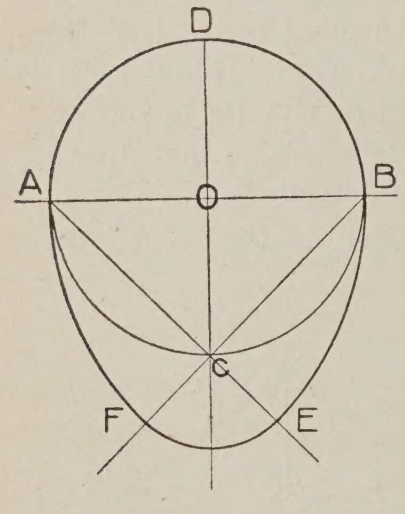
To draw an ellipse with pins and string:



Let AB and CD be the given axes intersecting at O. With D as centre and OB (that is, half the major axis) as radius, set off points E and F on the major axis. These are the foci of the ellipse.

Insert pins at E and F and fasten a string to them, the length of which is equal to EC plus CF. Insert the pencil point at C in the loop formed by the string and draw the ellipse.

Note: An ellipse has two foci and the sum of the radii from these two points is always equal.



To construct an oval having a given width:

Let AB be the given width. Bisect AB in O and with centre O and radius OB describe the circle ABC; draw diameter DC at right angles to AB. Through the point C draw the lines BC and AC; with A and B as centres and AB as radius, draw the arcs BE and AF. With C as centre and CF as radius, draw arc FE, thus completing the oval.

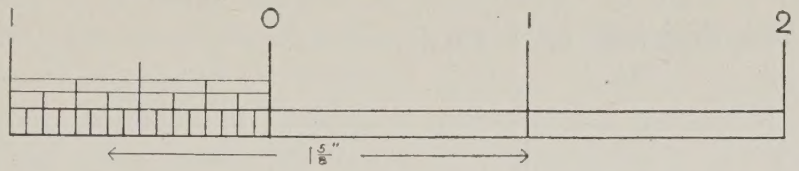
SCALES

The simple scales of "Full," "Half," and "Quarter" have been described in the work of Form III. The scales that follow, though slightly more complicated, are based on the same principle.

One-quarter inch to one foot:

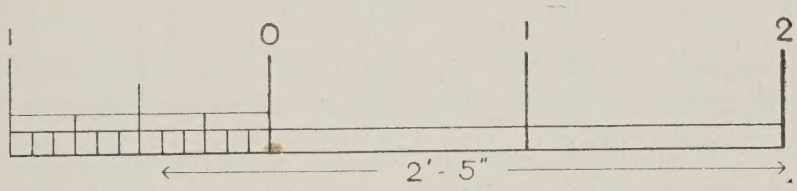
As ¼ in. is contained 48 times in 1 foot, so the RF (Representative Fraction) is $\frac{1}{48}$; that is, every line would be drawn $\frac{1}{48}$ of its actual length. Other scales are determined in the same way.

The following figures show the ordinary divisions of the English scale, and the manner in which they should be marked.



Note that the 0 like the decimal point separates the whole numbers from the fractions, and that the subdivisions are only marked in the division to the left. In using a scale, place one leg of the dividers upon the whole number given and the other upon the subdivision called for; for example, the dimension line shown above represents 1 in. and 5/8 in. First place one leg of the dividers on the one-inch mark and open them until the other leg reaches the five-eighths division, that being the fraction called for.

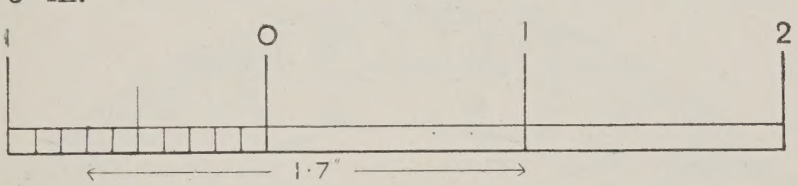
Note also that these various subdivisions are separated from each other by a horizontal line which makes them easily distinguishable. The subdivisions shown above are halves, quarters, eighths, and sixteenths of an inch. These could be further subdivided into thirty-secondths and sixty-fourths.



In the above, the subdivisions shown are halves, quarters, and twelfths.

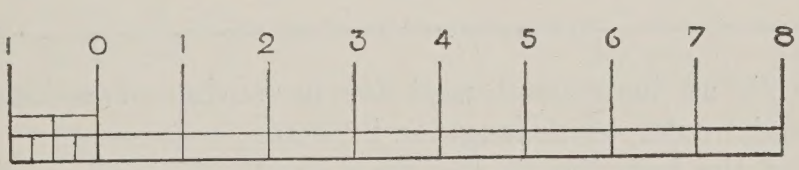
This is commonly employed when the scale 1 in. to the foot is used, as each of these small divisions represents 1 in. on the scaled drawing, which is very convenient when the ordinary English measure is in use.

With a scale of 1 in. to the foot, the dimensioned line marked above would represent 2 ft. 5 in.



In this Figure, the subdivisions are halves and tenths. This scale is necessary when decimals are used, as they often are on scaled drawings of machines; for example, the dimensioned line would represent 1 ft. 7 in.

To construct a scale of $\frac{1}{36}$ *or 1 inch to 1 yard; to represent 9 feet and show subdivisions to* 1/4 *foot*:

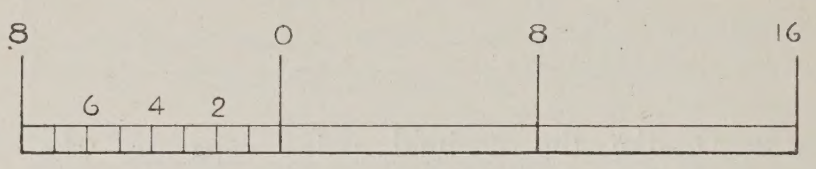


As 1 inch represents 3 feet the total length of line required will be 3 inches.

Draw a line three inches long and mark off the inches. Trisect one division. Measure one of these subdivisions with the dividers and set out the remainder.

As we are required to show ¼ foot, subdivide the division to the left as already explained.

To construct a scale of $\frac{1}{288}$, *that is, 1 inch equal to 8 yards; to measure 24 yards, and show divisions of 1 yard:*



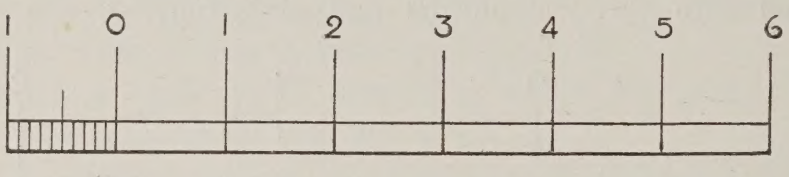
As 1 inch equals 8 yards, 3 inches will equal 24 yards.

Draw a line three inches long. Mark off the inches, and figure as shown in the diagram. Divide the inch to the left of the scale into 8 parts.

Metric Scale:

This scale is based on the metre which is equal to 39.37079 inches.

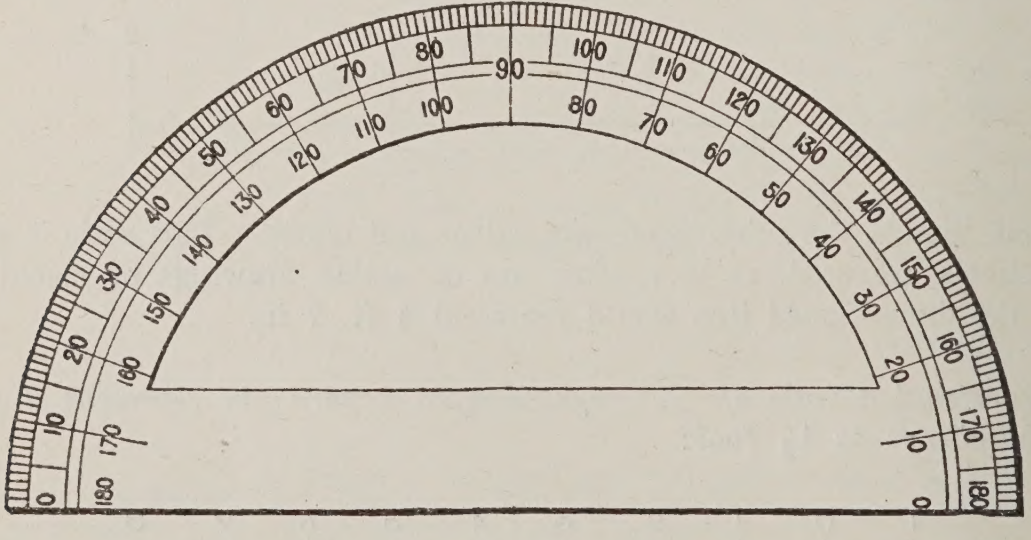
The metre is divided into 100 equal parts called centimetres, seven of which are shown in the Figure.



The centimetre is divided into ten equal parts called millimetres. This is a very simple scale from which even young pupils can obtain very fine measurements without having any difficult calculations to make in fractions, which would be the case if the English scale were used.

The 0 corresponds to the decimal point in the decimal notation.

Protractor:



A protractor is an instrument used for measuring or setting off angles; it may be either semicircular or rectangular in shape.

The centre of the base line is the point from which the radiating lines are drawn and corresponds with the centre of the circle. The degrees are numbered in primary divisions, equal to ten degrees each, on the outside line from the left, and on the inside line from the right. These primary divisions are subdivided into ten secondary divisions, each of which represent one degree.

PLANS AND ELEVATIONS

General Principles

In the instruction on object drawing previously given, the fact will have been learned that a surface exactly in front of the eye (that is, in the line of vision) whether horizontal, vertical, or oblique is always represented by a line. If such instruction has not been given, the above principle should be fully demonstrated, as the following method is founded on that principle.

A surface, viewed edgewise, exactly in front of the eye must be directly in the line of vision, and the projection of any point on that surface will be where the ray of light from the eye meets the vertical plane behind the object.

Method of Presentation:

Hold up a sheet of paper, or other thin material (supposed to have no thickness) in various positions directly in front of the eye.

First Position:

Paper horizontal, and level with the eye. Suppose we were object-drawing; how would this paper be represented? By a horizontal line.

Second Position:

Paper horizontal, level with the eye, and one angle toward the eye.

How would it appear now on our drawings? It would appear as a horizontal line. (Explain that it would really be two straight lines joined end to end, making one straight line).

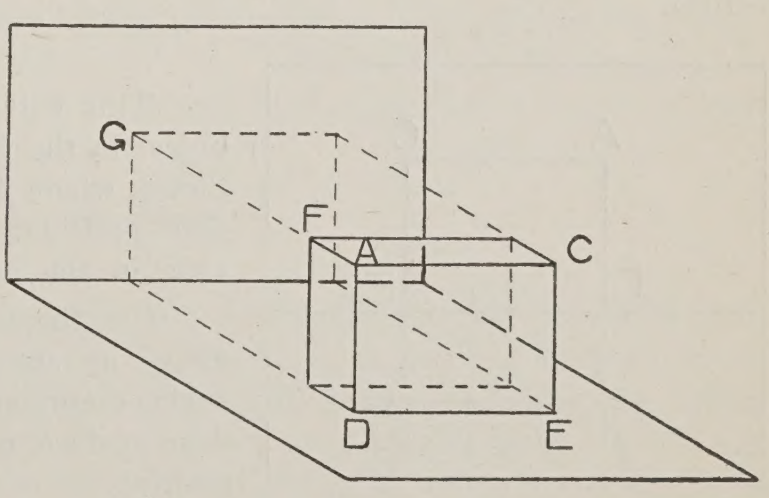
Take other positions in the line of vision, but having the surfaces vertical, and oblique, and question in a similar manner.

Another fact to be noticed is that in object drawing the eye must be kept stationary, or different views will be obtained; whilst in orthographic projection *the eye is supposed to move directly opposite to every point.* Therefore all surfaces in the line of vision, viewed edgewise, will be represented by lines.

Application of Principle

Some simple object as a common brick or a piece of wood, 1 in. x 3 in. x 4 in., will serve for a first lesson. The actual object must be presented to the pupils in order that they may identify the points, lines, and surfaces referred to throughout the lesson.

Let a boy measure one of the large surfaces of the object. Then place it in position as shown in the diagram.



If a swing board is not available, let the object rest on some flat surface at right angles to the black-board. Then, assuming that the upper surface of the object is level with the eye, question regarding the method of representing that surface.

It will be shown by a line 4 in. long. This may now be drawn in a suitable position on the paper. Treat the lower, right, and left surfaces in the same way, thus getting an oblong 3 in. x 4 in.

Along the edge marked AF place a wire rod, or thin stick reaching to the black-board. If we were object-drawing and this rod were directly in the line of vision, how would it appear in the drawing? It would be represented by a dot (.).

We have now obtained two important facts in orthographic projection, namely:

(*a*) That a surface, in the line of vision, will be represented by a straight line, and,

(*b*) That a line, in the line of vision, will be represented by a dot.

When a surface is at *right angles* to the line of vision, its true shape will be seen in the drawing. This may be illustrated by using cards of different shapes and holding them before the class. When held in the line of vision, the resulting drawing will be a line, no matter what the shape of the card may be. When held at right angles to the line of vision, the real shape of the card will be shown.

Note that each wire represents a portion of the line of vision when the eye is in front of each corner. As the rod representing the line of vision carries each point to the black-board, what will be the size of the drawing? The size will be exactly the same as that of the object.

It is highly important that the pupils understand that they are not simply drawing the *edges,* but that the lines forming the rectangle represent the *surfaces* which form the *sides* of the object. This may be illustrated by placing a sheet of paper against each side successively, and reminding the pupils that they are supposed to have their eyes exactly in front of each side when they are drawing it.

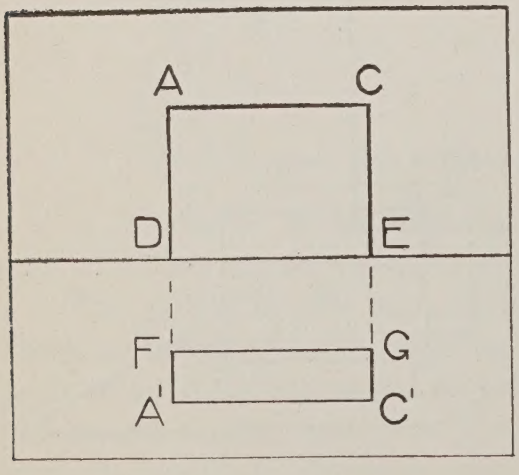
The next step is to teach how to "swing" the object with its supporting plane, when representations of the other surface are required.

Take, for example, the view from above (plan). Question the boys as to where they would have to go to be able to look straight down upon the upper surface. They would have to go above the object.

Explain that this would not be convenient, and that their papers are not folded like the swing board, therefore we must swing the object so that the upper surface is at right angles to the line of vision.

How can we do this?

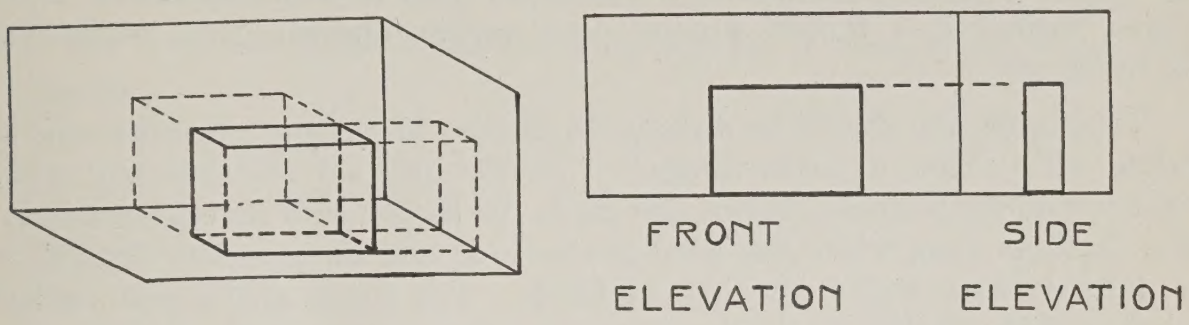
We must swing the horizontal board and the object down until the board is vertical.

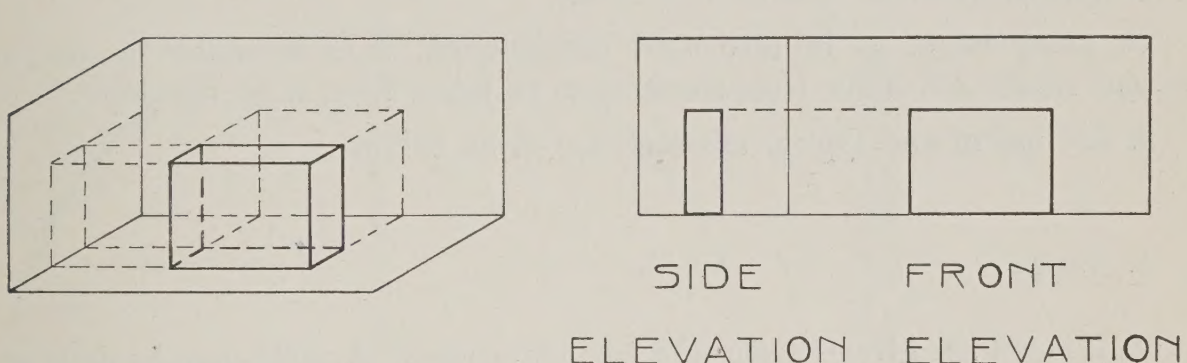


This will bring the upper surface of the object to the front, and will give a position as shown, where ACED represents the view in the first position, whilst FA′C′G represents the view in the second position.

Get the pupils to notice (by black-board ruler, or straight piece of wood) that the surface represented by FA′, is directly below the same surface, as represented by AD in the first position.

Swing to the right and left in a similar manner. The first Figure below shows the projection when swung to the right. The second Figure shows the projection when the model is swung to the left.





Get the pupils to notice that when we view the object from *above,* the projected drawing will be below the first view drawn; when viewed from the *right,* the projection will be on the left; when viewed from the *left,* the projection will be on the *right.*

If these principles are understood, the orthographic projection of simple objects will present no serious difficulties.

The pupils have now learnt that the lines of vision (that is, the rays of light from the eye to and beyond the object) meet the black-board, or vertical plane, at right angles. They have also learned by the swinging of the model, that the projectors (that is, the dotted lines from the original view to the projected view), are always at right angles to the view first drawn. For this reason this method is called "orthographic" projection, that is, right-line projection.

After the different projections of this or a similar block are understood, it will be well for the teacher to treat the typical solids in the same way and have plans and elevations drawn of each.

The drawings given for work in wood should be studied from the point of view of plan and elevation.

WOOD-WORK

The work in thin wood suggested for Form III may be continued with advantage. In this Form the work will be of a more advanced character, introducing in an elementary way the principles of construction adopted in the industries. Much greater stress should be laid on the mechanical drawing. Where one or two benches, as suggested in the chapter on "Materials and Equipment" can be provided, the scope of the work may be much extended.

When given the opportunity, boys will do work of various kinds without much definite instruction. Much work of this character has been done during recess and out of school hours. Boys can be induced by suggestion to undertake many minor repairs in the school and around the grounds, such as mending fences, repairing latches, putting in a broken window pane, making garden seats, window boxes, tool racks, etc.

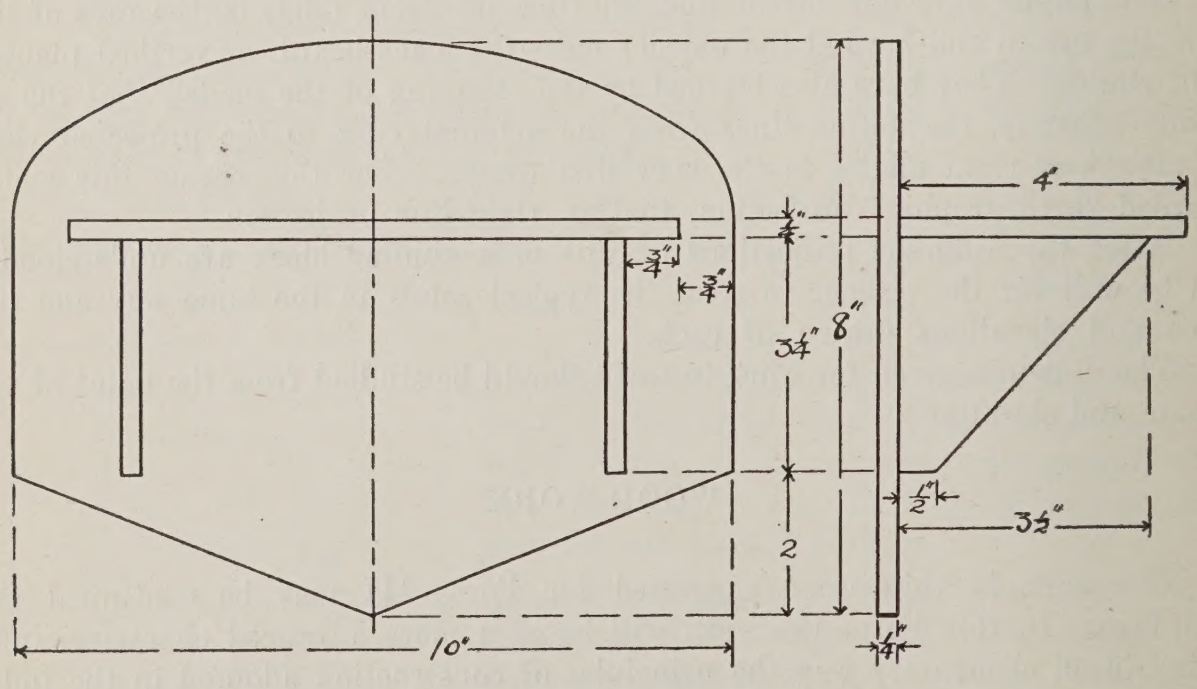
Their attention should be directed to articles in various magazines and books dealing with "How to make things." As the different materials are used, the pupils should study brads, screws, and glue; the timber with its characteristics and uses; the trees from which the wood is obtained; and the processes through which the lumber passes before reaching our hands. The pupils should make collections of leaves of the typical lumber-bearing trees, also pictures of the lumber industry, and of trees at different seasons of the year.

In many cases, as in cardboard construction, it is advisable to prepare a specimen model and allow measurements to be taken from it by the pupil.

A few useful and typical exercises are given below.

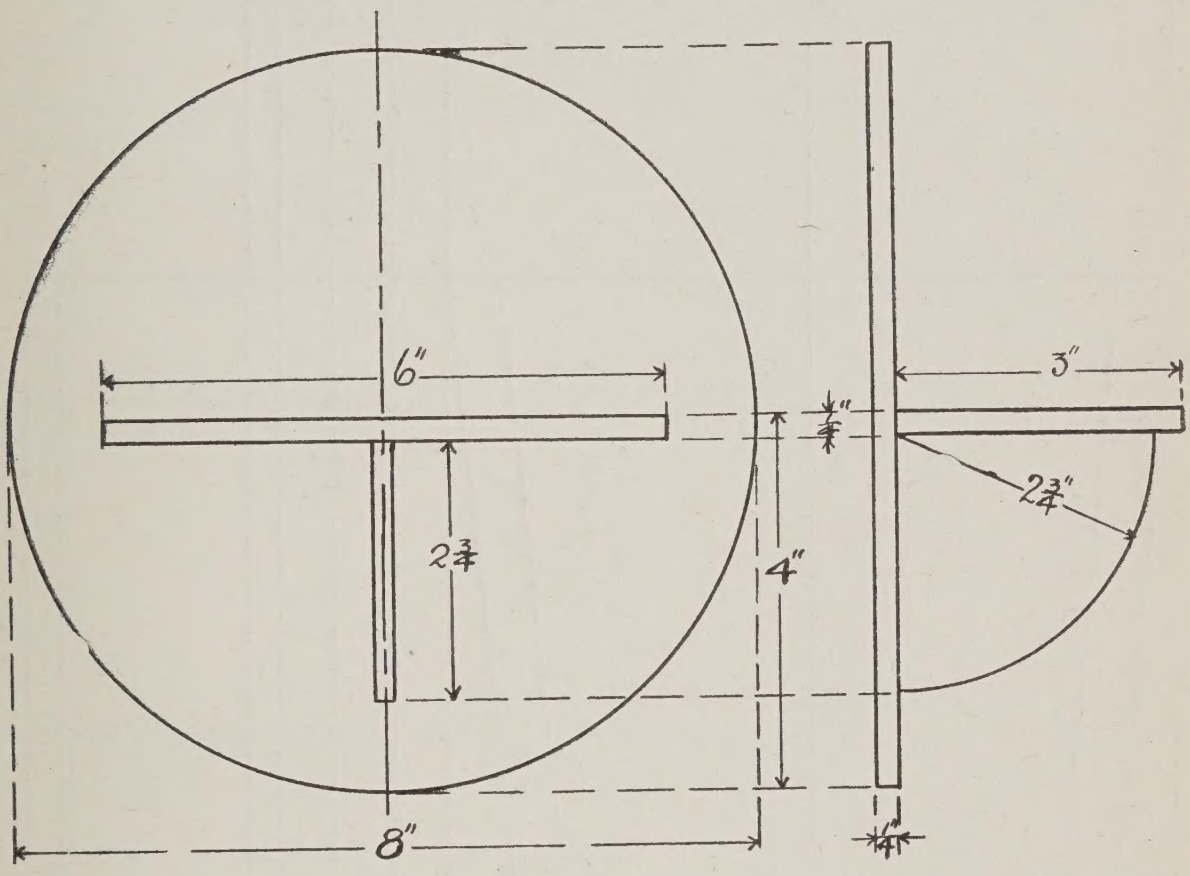
1. *Shelf*:

Two views are given—front and side elevations. A shelf may be designed by the boy for his individual use. The one shown consists of four parts—back, shelf, and two supporting brackets. A piece for the back may be selected and the desired design drawn. The shape of the supports may be modified, care being taken that the angle between the shelf and the back is a right angle. The parts are fastened together with glue and fine brads; very fine screws may be used.



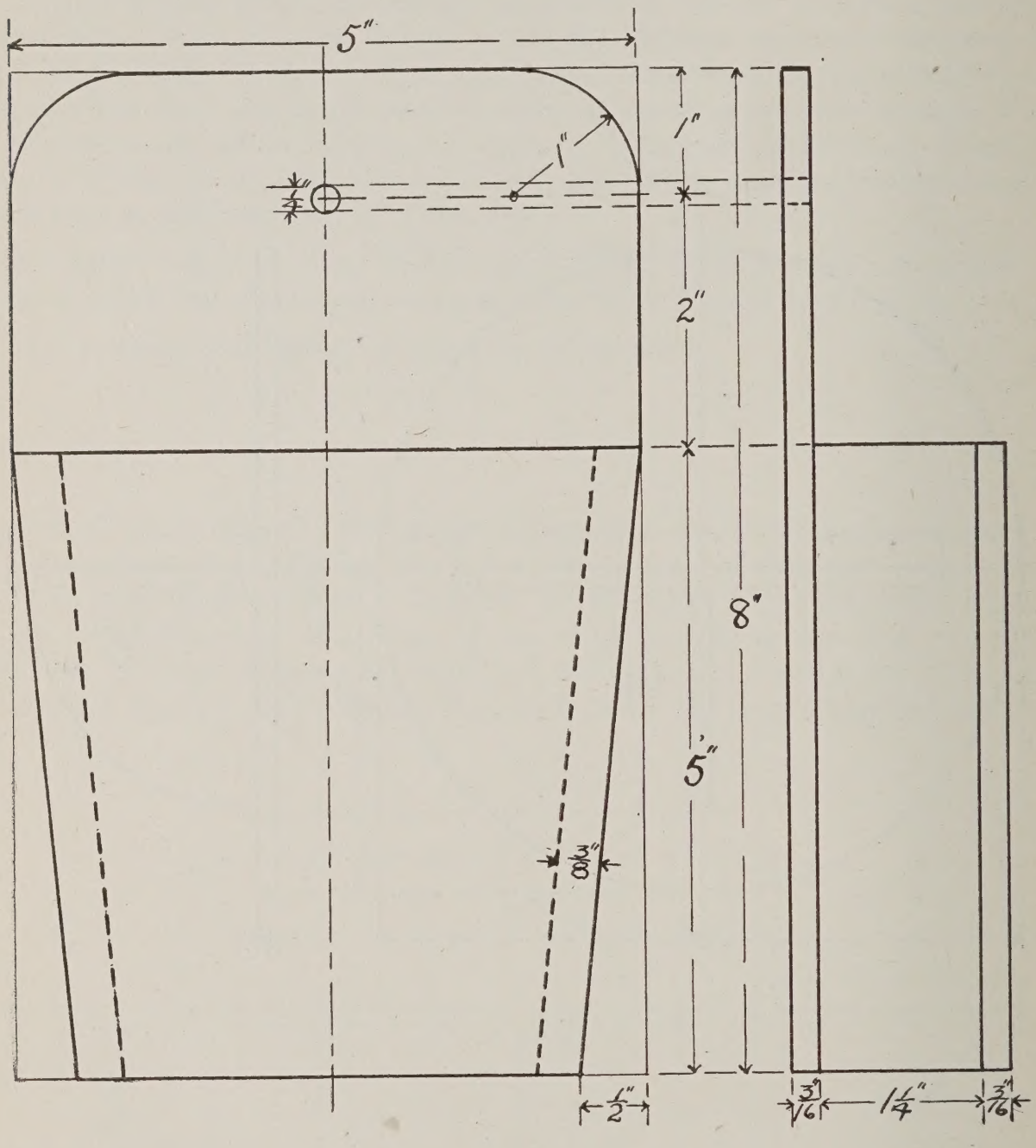
2. *Clock Shelf*:

Cut an 8-in. circle for back. For shelf and braket cut a 6-in. circle. One half of this forms the shelf. Half the remainder cut to a radius of 2¾ in. forms the support.



3. *Whisk Broom Holder*:

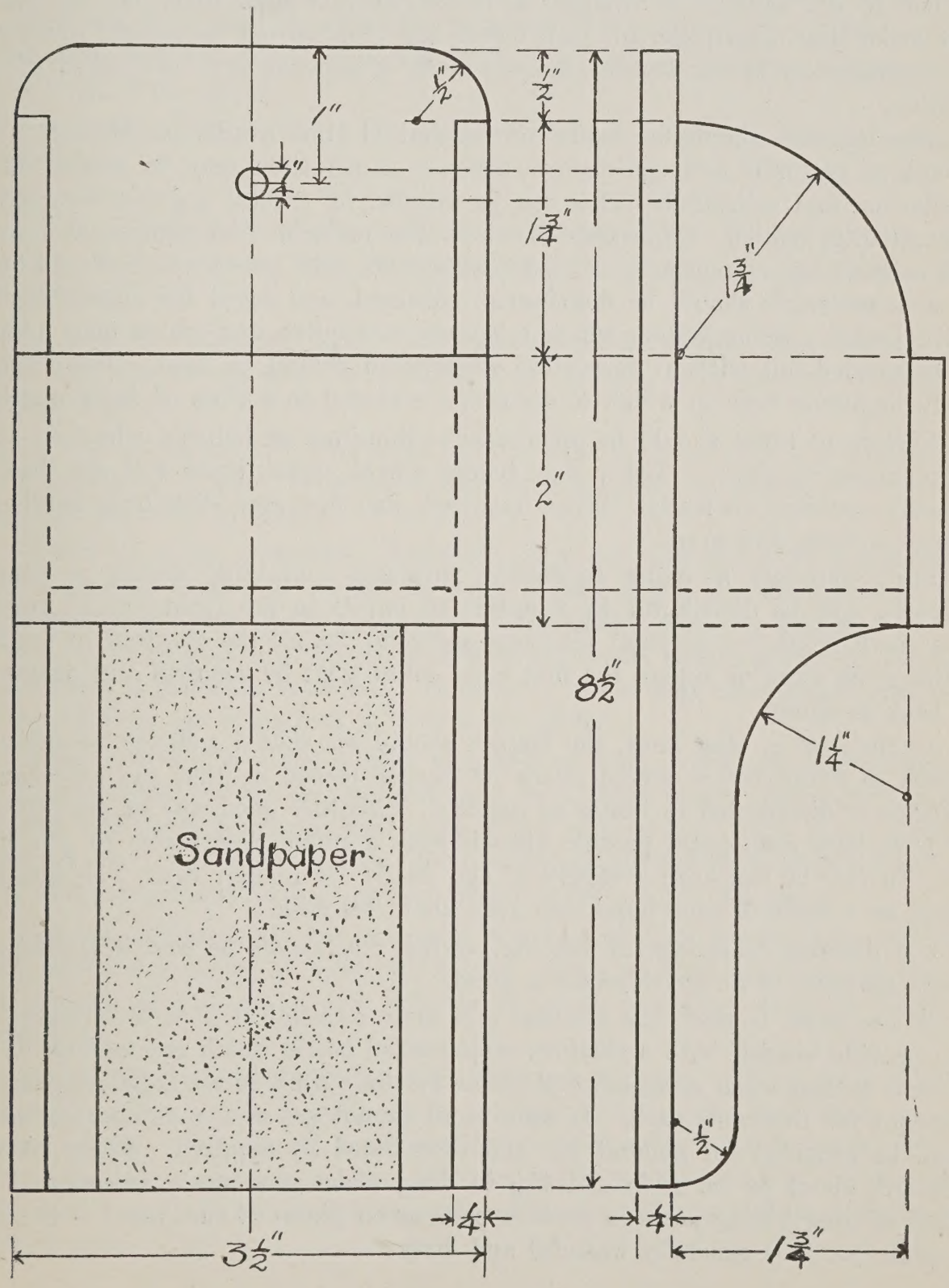
For the back, make the drawing as shown on a centre line. Cut to the lines with a knife. In a similar way set out and cut the front. Cut the sides to the desired shape. Nail the back and front to the sides with brads ¾ in. apart, and sink the heads a little below the surface of the wood.



4. *Match Safe*:

This model consists of five pieces. Set out the work on one piece of wood according to the sizes shown. Nail together as before. The design of the upper portion of the back may be modified as desired.

A series of suggestions, pages 83, 84, have been given previously for work in thin wood, known as strip work. These strips may be obtained planed to width and thickness. The articles shown are typical of many that can be made in heavier material when facilities are provided. Wheels may be cut with a centre-bit of the correct size and having its horizontal cutter filed away.



SUGGESTIONS TO TEACHERS

Previous to teaching the making of any object, it is essential that the teacher himself should have made it. This is indispensable to a successful lesson. A careful study should then be made of the different steps, and their order determined. By making the model the teacher will discover which steps in the process are liable to lead to difficulty and, therefore, need special emphasis in teaching. In the majority of cases two models should be made—one the exact size from which the pupils can take measurements, and the other, two, three, or four times the size. The latter can be used for demonstration purposes. The description of each problem in this Manual is intended to be helpful and suggestive, but the teacher must make that description his own before the problem can be taught effectively. The individuality of the teacher determines to a large extent the method of presentation.

The best use should be made of the limited time available. Owing to the amount of material and equipment requisite, much time may be wasted in its distribution and collection. This can be avoided by careful organization and by systematizing details. Cupboards in which the material and equipment may be kept, each in its own place and readily accessible, will prove of great assistance. All such materials should be distributed, collected, and cared for almost entirely by the pupils. Some system which is speedy and quiet, and which once adopted can be carried out without very close supervision should be used. Two minutes should be ample time in which to distribute material to a class of forty pupils.

Certain children should be appointed as monitors or helpers, who will assist in preparing material. Every day, before school opens, these will see that the necessary material is ready. When required, one boy may distribute cardboard, another scissors, and so on.

Such materials, as paper, cardboard, envelopes containing sewing or weaving materials, may be distributed by monitors to pupils in the front or end rows of desks; each front or end pupil receiving sufficient for all the children in his row. At the given word or signal, the first child takes what he requires and passes the rest back or along.

In the case of clay work, the helpers should see that a sufficient quantity of material is ready before school opens or during recess, so that the clay can be immediately distributed in lumps as required. Another good way of dealing with clay is to have each pupil provide himself with a small glass sealer (a pint jelly jar). In this he can keep a supply of clay ready for instant use. The jars may be kept on a shelf, or each pupil may keep his in his desk.

Cut pictures, materials for weaving, sewing, etc., should be kept in envelopes—enough material in an envelope for a pupil.

Where paste is used, the cleanest and most economical plan is to have each pupil provide himself with a shallow, wide-necked bottle which can be kept in the desk and refilled when necessary. Suitable bottles with a screw metal stopper can be bought for five cents each. If each pupil cannot get one, a number of bottles should be provided for general use and distributed as required. Pieces of stiff cardboard, about ¾ in. wide and 1½ in. long make good paste spreaders. The method of distributing paste in shallow pans or on pieces of cardboard is the next best plan, but it is generally wasteful and dirty.

Everything should be put away in good order; this saves time next day.

The instructions given should not be confined to "model making." It is always profitable to spend two or three minutes in showing the relationship of the work being done to the problems which preceded it, and also to work done outside the school. Geometric principles and terms should be taught as the necessity for them arises. In teaching the drawing required for any particular model, the outline common to the entire figure should be drawn before spacing and drawing details. Whatever shape or form a figure may have, there is always some geometric motive and some regular outline defining and inclosing it. Where the inner details of a figure depend on the motives of outlines of a circle, a square, or a rectangle, these latter must be drawn first. Proceed from without inward.

Reduced to a principle this may be stated thus: Draw the outline and then divide into definite spaces to obtain proportion and symmetry. Allow only a limited use of the eraser.

In teaching the making of any particular object the following method is suggested:

1. An investigation of the model by teacher and pupil for the purpose of discovering its development and of ascertaining the shape and dimensions of the material required.

2. The construction of the development of the object from measurements taken from the model, and the completion of the object by folding, cutting, and pasting, etc.

3. The giving of exercises based on the work done, to enable the children to apply and extend their knowledge, and to encourage initiative. The exercises should be regarded as typical.

Avoid too many directions. Generally, it is not wise to tell the pupil what he can discover for himself in reasonable time. A good model is often the result of too much instruction and, if the production of the model were the object to be aimed at, this would be well, but the production of the model should always be subsidiary to the thought processes involved. An inferior model may often mean more to the individual than the one which is technically perfect.

Aim from the first for a high standard of work. Give exercises which are within the ability of the pupils, and have them done well. Giving very difficult exercises and then being satisfied with a low standard of work has a decidedly injurious effect. At the same time the exercise should not be so simple that it can be performed without distinct mental effort on the part of the pupil.

Always encourage the suggestion of other methods of construction and decoration, and the devising of ways and means. Even if these ways are not the best, it is sometimes well to let the children try them and then compare them with others.

Throughout the whole of the work, neatness, tidiness, and accuracy should be cultivated. The pupils should not be allowed to litter the floor with scraps of paper. Every pupil should make or be provided with a large roomy envelope inscribed with his name, to contain pictures, cuttings, and scraps of cardboard that will likely be of service in future work. Economy of material should always be insisted upon.

When it is necessary to give directions, they should be brief and clear. No more words should be used than are necessary to give the definite instruction required. Vary the expression of these directions so as to avoid monotonous repetition of the same forms. The black-board should be freely used and the lines drawn should always have the same meaning. For example, a dotted line should always represent a fold and not a fold at one time and a construction line at another.

A valuable method for Forms I and II especially, is to go through every process and make the complete object before the class. At one time this may be done before the pupils begin work and, during the process, the pupils are expected to observe exactly what is done by the teacher so that, when they begin work, they will be able to construct the object entirely from their own knowledge. At another time the teacher may make the object, step by step, the pupils constructing their objects as he proceeds. At other times a lesson may be given entirely by directions.

After the pupils have had a certain amount of training the plan should occasionally be adopted of placing a drawing on the black-board and having the model made entirely from it.

In a small class the pupils may make a model from one previously made by the teacher or an older pupil. Much of the work will of necessity be done during seat-work periods.

A successful lesson in this work is marked by certain characteristics: on the part of the teacher—by a thorough acquaintance with the subject gained through previous preparation; clear and concise direction, and adoption of correct technical methods; and on the part of the pupil—by strict attention to the directions given, concentration, earnestness, a spirit of cheerfulness and enjoyment; and by the production of the best work of which he is capable at that stage.

In arousing and stimulating interest in this work amongst parents and pupils, exhibitions serve a useful purpose. If no better place be available, these may be held in the class-room. It is advisable not to crowd the exhibits. Various exhibits—hand-work, drawing, art, garden products, collections of minerals and fabrics, or other educational material may well be made periodically.

BOOKS FOR REFERENCE

The more important books are marked with an asterisk.

WEAVING AND BASKETRY

Hand Loom Weaving. Todd. 90c. The Geo. M. Hendry Co., Limited, Toronto.

Well illustrated, clear and concise directions for weaving many simple articles. Contains a useful list of helpful books and magazine articles.

***Practical and Artistic Basketry.** Tinsley. $1.00. McClelland & Goodchild, Toronto.

Contains an outline of a course in basketry for the public schools. One of the clearest books on the subject, containing much not found elsewhere.

Baskets and How to Make Them. White. $2.00. McClelland & Goodchild, Toronto.

More Baskets and How to Make Them. White. $1.00. McClelland & Goodchild.

Two standard works by a recognized authority. Materials fully described and full instructions given. Well illustrated. The first-named book is the better one.

Raffia and Reed work. Knapp. 50c. The George M. Hendry Co., Ltd., Toronto.

Outlines a course from the kindergarten, through the public school grades, in paper weaving, cardboard, raffia, etc. Well illustrated. All weaves clearly shown.

Indian Basketry. James. $2.50. McClelland & Goodchild, Toronto.

A thoroughly comprehensive work. Over 600 illustrations, showing all the different weaves and stitches.

Primary Hand Work. Seegmiller. 50c. Educational Book Co., Ltd., Toronto.

Helpful and suggestive for the primary teacher. Deals largely with paper weaving for children six years of age and upwards. Forty diagrams.

Aboriginal American Basketry. Mason. Gratis. Smithsonian Institution, Washington, D.C.

Probably the most monumental work on basketry ever published. Issued as one of the Annual Reports of the Bureau of Ethnology. Two hundred and forty-eight full page plates (many in colours) and 212 text figures. Out of print, but copies are occasionally met with, and the opportunity of obtaining one should be eagerly seized. May be found in many Public Libraries.

Varied Occupations in Weaving. Walker. $1.00. The Macmillan Company of Canada, Limited, Toronto.

One hundred and seventy-eight illustrations. Treats of various kinds of weaving in paper, ribbon, string, straw, and cane.

PAPER AND CARDBOARD

Paper Sloyd for Primary Grades. Rich. 75c. Ginn & Co., New York.

Contains 47 drawings of cardboard models, divided into three years, and 14 supplementary models with full directions for making.

***Story Telling with Scissors.** 50c. The Geo. M. Hendry Co., Limited, Toronto.

An excellent little manual for primary work. Sixty-two plates, black on white, with appropriate verses.

Busy Hands Constructive Work. Bowker. 60c. McClelland & Goodchild, Toronto.

Useful for primary teachers. Deals with a variety of materials. Work divided according to seasons.

Manual Arts with Scissors. Moran. 75c. The Geo. M. Hendry Co., Limited, Toronto.

Contains illustrative free cutting exercises for each month. Well got up, and good for reference.

Cardboard Construction. Trybom. $1.00. The Geo. M. Hendry Co., Limited, Toronto.

Drawings and instructions for 65 models. Six preliminary lessons on the use of necessary tools.

First Years in Handicraft. Kenyon. 70c. Baker & Taylor Co., New York.

A series of 50 simple articles in paper and thin cardboard, suitable for children from 7 to 11 years of age.

***Paper and Scissors in the School Room.** Weaver. 25c. The Geo. M. Hendry Co., Limited, Toronto.

Two hundred and twenty-two illustrations; based on geometrical figures and tains useful hints and suggestions.

Plan Book with Scissors and Paste. 25c. McClelland & Goodchild, Toronto.

A series of 50 drawings, white on black, as suggestions for paper cutting, with an introductory chapter of directions.

***Paper Modelling.** Swannell. 2s. 6d. George Philip & Son, Ltd., London.

Very useful and suggestive, deals with common objects as found in every home. Something agreeably different from the ordinary exercises.

***Paper Folding for Schools.** Hopkins. 9d. Charles and Dibble, 10 Paternoster Square, E.C., London.

Very useful pamphlet, containing instructions for making various articles (49) by simple foldings. Illustrated by numerous diagrams.

***Paper and Cardboard Construction.** Buxton and Curran. $1.50. McClelland & Goodchild, Toronto.

Covers book, box, card, and envelope problems for the first four grades and suggestions for equipment, supplies, and methods.

The Original Mother Goose Rhymes. J. F. Goodridge. 50c. Lothrop, Lee and Shepard Co., Boston.

CLAY

***Modelling for the Standards.** 40c. The Geo. M. Hendry Co., Ltd., Toronto.

Plastic Methods for Plastic Minds. 35c. The Geo. M. Hendry Co., Ltd., Toronto.

Easy Modelling for Infants. 20c. The Geo. M. Hendry Co., Ltd., Toronto.

How to Use Plasticine. 15c. The Geo. M. Hendry Co., Ltd., Toronto.

Above books well illustrated. Most of the objects given could be modelled in clay, as well as plasticine.

***Modelling in Public Schools.** Sargent. 75c. J. L. Hammett Co., 250 Devonshire Street, Boston.

A Manual of Clay Modelling. Unwin. $1.00. Longmans, Green & Co., London.

Sixty illustrations of natural and common objects. Very helpful.

Clay Modelling. Holland. 75c. Ginn & Co., New York.

Gives a progressive course of models for the grades. Contains a useful introductory chapter and 18 plates.

Plaster Casts and How they are Made. Fredrick. $1.50. Wm. T. Comstock. 23 Warren Street, New York.

Shows clearly how to take a plaster cast of a clay model, with much useful information on clay modelling. A good book, includes much more than its title indicates.

***Clay Modelling for Little Ones.** Pearce. 9d. George Philip & Son, Ltd., London.

A useful manual, based largely on natural forms; good on method; well illustrated.

***Clay Modelling.** Fletcher. 3s. 6d. George Philip & Son, Ltd., London.

An educational occupation for young children, based on geometrical figures and natural objects. Closely correlated with geography.

Clay Work. Lester. $1.00. McClelland & Goodchild, Toronto.

Deals with plant form, human figure story illustration, simple architectural ornament, titles, and elementary pottery.

Clay Modelling for Infants. 60c. F. H. Brown, A.R.C.A. The Copp Clark Co., Limited, Toronto.

VARIOUS MATERIALS

Constructive Work. Worst. 75c. A. W. Mumford, 157 W. Adams Street, Chicago.

Manual training related to number work, history, literature, and nature study. A chapter on vegetable dyes. A very useful book.

Hand Work for Kindergarten and Primary Grades. Hoxie. 50c. The Geo. M. Hendry Co., Ltd., Toronto.

A useful book, dealing with wood-work for primary grades, raffia weaving, etc., and the making of blue prints from leaves.

***What and How.** Palen and Henderson. $2.00. The Geo. M. Hendry Co., Ltd., Toronto.

Suggested "Time Table" given. Illustrations excellent. Exercises for special days. A very good book.

***Seat Work and Industrial Occupations.** Gilman and Williams. 50c. The Macmillan Company of Canada, Ltd., Toronto.

One of the best of the low-priced books.

***Educational Hand Work.** T. B. Kidner. $1.25. The Educational Book Co., Ltd., Toronto.

A chapter on elementary descriptive geometry. A good book.

***School Drawing—A Real Correlation.** Daniels. $1.20. The Geo. M. Hendry Co., Ltd., Toronto.

Correlates drawing, sand and clay modelling, paper work, etc., with history, literature, geography, etc. Should be in every school.

Arts and Crafts for Beginners. Sanford. $1.00. Century Co., New York.

Deals with thin wood-working, pyrography, sheet metal working, leather tooling, book-binding, pottery making, basketry and bead work. Good for higher grades.

Construction and Flying of Kites. Miller. 25c. McClelland & Goodchild, Toronto.

An exceedingly useful and interesting pamphlet for boys.

Correlated Hand Work. Trybom and Heller. $1.25. The Geo. M. Hendry Co., Ltd., Toronto.

Correlates work in clay, paper, cardboard, etc., with the ordinary work of the schoolroom.

Occupations for Little Fingers. Sage and Cooley. $1.00. McClelland & Goodchild, Toronto.

Includes suggestions on the use of cord, string, raffia, and clay, sewing, paper cutting, and folding, weaving, crocheting, knitting, and the furnishing of a doll's house.

Industrial Work for Public Schools. Holton and Rollins. 90c. Rand-McNally & Co., New York.

Eighty half-tones. A course of four years' work in various materials.

How to Make and How to Mend. $1.00. The Macmillan Company of Canada, Limited, Toronto.

Arranged in dictionary form. Should be in every school and home.

Geometrical Drawing and Design. Spanton. 60c. The Macmillan Company of Canada, Limited, Toronto.

Plane and Solid Geometry. Morris. 3s. 6d. The Macmillan Company of Canada, Limited, Toronto.

GENERAL

***Industrial Social Education.** Baldwin. $1.50. The Geo. M. Hendry Co., Ltd., Toronto.

Deals with practical school problems and the possibilities of the various hand-work processes.

Book Binding and Care of Books. Cockerell. $1.25. D. Appleton & Co., New York.

A well written and fully illustrated book on the technical processes of bookbinding, by a famous English binder.

The American Boy's Handy Book. Baird. $2.00. Charles Scribner's Sons, New York.

Three hundred and twenty illustrations. One of the best boy's books on "What to do and How to do it."

***School and Society.** Dewey. 75c. Doubleday, Page & Co., New York.

Outlines the educational and sociological significance of nature study and the manual arts in school life.

Education and the Larger Life. Henderson. $1.30. Houghton Mifflin Co., New York.

Leads from accepted theory and practice to new and larger fields. Makes an inquiry into education in its broadest aspects.

Home Mechanics for Amateurs. Hopkins. $1.00. Munn & Co., New York.

An excellent book for a boy with a turn for experiment.

***The Place of Industries in Elementary Education.** Dopp. $1.00. University of Chicago Press, Chicago.

Offers much toward solving the problems of hand-work in the grades, both lower and higher. Should be studied by every teacher.

***Year Books of Council of Supervisors of Manual Arts.** 7 vols.; $3.00 each. Ed. D. Griswold, Hastings-on-Hudson, New York.

Deal with all forms of manual arts in the schools. Of the greatest value.

WOODWORK.

***Hand Work in Wood.** Noyes. $2.00. McClelland & Goodchild, Toronto.

Covers logging, saw-milling, seasoning, measuring, hand tools, fastenings, equipment, joints, and furnishing. Three hundred and four illustrations. An excellent book.

***Woodwork for Beginners.** Wheeler. G. P. Putnam's Sons, New York.

A very suggestive book. Deals with a variety of subjects, all interesting to boys. Thoroughly recommended.

***Woodwork on Scientific Lines.** Bailey and Pollit. 75c. McClelland & Goodchild, Toronto.

Contains a number of educational exercises, many of them being pieces of apparatus for elementary science. A very useful book.

The New Education, Manual Training Woodwork. Wake. 10s. 6d. Chapman & Hall, Ltd., London.

Gives a three years' course in woodwork for public schools. Good on method, leading to design and invention. Well illustrated.

Educational Handwork. Goetze. Newmann & Co. 84 Newman Street, London.

Gives a course for rural schools, garden work, woodwork, metal work, etc.

Elementary Woodworking. Foster. 60c. Ginn & Co., New York.

Deals with tools and their uses. Second half of the book deals with timber and trees. One hundred and thirty-six illustrations.

Woodworking in the Common School. Hinckley. $1.00. The Geo. M. Hendry Co., Ltd., Toronto.

Deals with woodwork, in the class room, by the grade teacher. Two hundred and seventy-five drawings.

***Coping-saw Work.** Johnson. 25c. McClelland & Goodchild, Toronto.

A useful book of suggestions for "Out of School" work.

Timber and Tools. Wallace. $1.25. T. Nelson and Sons, London.

Two hundred and eighteen pages. Deals with the constructions of tools and the application of timber to industrial purposes.

Elementary Woodwork. Selden. Rand-McNally & Co., Chicago.

Two hundred and six pages. Well illustrated. A series of 42 exercises. Tool operations, illustrated from photographs.

***Toys and Toy Making.** G. F. Johnson. $1.00. Longmans, Green & Co., London.

***Manual Training Toys.** $1.00. Manual Arts Press, Peoria, Illinois.

MAGAZINES

Manual Training Magazine. $1.75. McClelland & Goodchild, Toronto.

***School Arts Book.** $1.75. School Arts Publishing Co., 120 Boylston Street, Boston.

FORM V

COURSE OF STUDY

Junior Grade

Drawing.—Review of the courses of Forms III and IV. Simple plans and elevations. Correct use of drawing-board, T-square, triangles, and compasses. Construction of the common geometrical figures. Simple lettering and figuring. Working drawings of objects made, either full size or to scale.

Wood Work.—Review of the Public School Course. Growth, structure, and identification of the woods used in the manufactures of the locality. Warping, twisting, checking—how caused and counteracted. Making of simple objects according to drawings previously prepared. Proper use of nails, screws, and glue. Use of simple joints in articles made: for example, end half lap, centre half lap, mitre, housing. Use and mechanical construction of common wood-working tools as exemplified in the making of a series of useful objects. Construction of simple school apparatus.

Senior Grade

Drawing.—Elementary orthographic and isometric projection. Simple sections. More advanced geometrical drawing. Freehand dimensioned sketches. Inking, tracing, lettering, and blue printing. Working drawings of objects made.

Wood-Work.—Growth, structure, and identification of the woods used in the locality. Tool sharpening. Common joints used in various kinds of wood-work —scarfing, simple dovetail, mortise and tenon, tongue and grooved joint—their use in making objects such as boxes, drawers, tables, book-cases, etc. Fastenings with dowels, pins, cleats, wedges, etc. Calculations, from drawings and specifications, of lumber required for articles made and the cost. At least every alternate piece of work must be kept for inspection.

Various methods of finishing, as staining, fuming, filling, shellacing, oiling.

Wood Turning.—Explanation of the lathe, its action, speed, parts, care, and use. The gouge; correct position, turning rough cylinder. The skew chisel; reason for grinding both sides and at an angle. Concave surfaces with skew chisel; review exercises. Irregular curves and spindle work. V grooves, beads, and hollows. The introduction of hard wood and sandpaper; exercises in turning handles. Face plate turning, chuck work, boxes with covers, powder box, napkin-rings, goblet, etc. Every piece of work must be kept for inspection.

Forging.—The forge, the fire, the heat, the height of anvil, and its position.

The ordinary tools; how to use and care for them. Hammer, sledge, chisel, fuller, and swage. Drawing, forming, upsetting, bending, and twisting iron, stamping and forge-blacking and finished piece; exercises of simple design and construction, as gate hook, turning eye and hook. Scarfing, bending, and welding. Every piece of work must be kept for inspection.

Machine-shop Practice.—Simple ornamental work in brass, copper, and iron. The making of simple objects, such as watch fobs, paper knives, blotter corners, trays, bowls, etc.

Simple clipping and filing. Use of measuring and marking tools.

An elementary study of the engine lathe; its parts, adjustment, and working. Proper tool angles and cutting speeds and feeds. The exercises taken should, where possible, involve completed objects. All work must be kept for inspection.

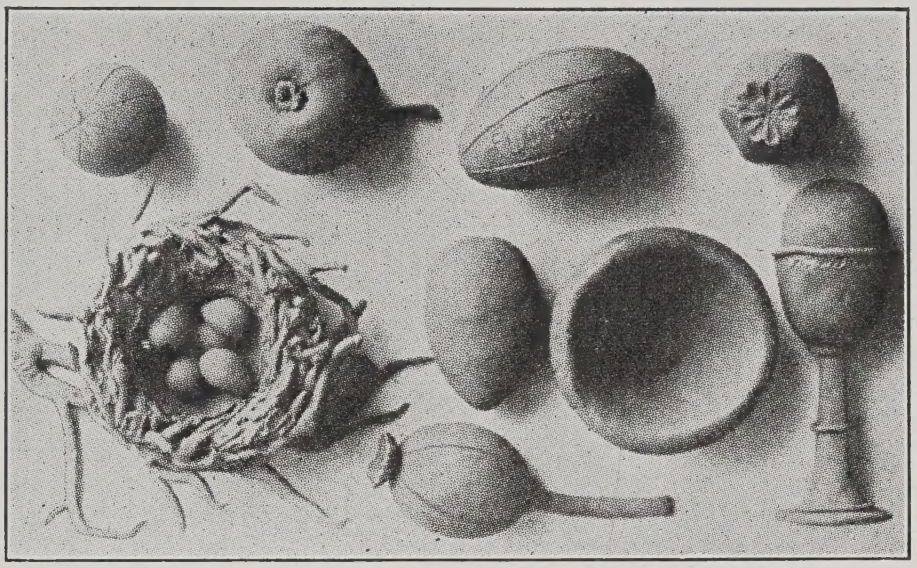


Plate 1.—Models that can be made from a ball. Suggest others

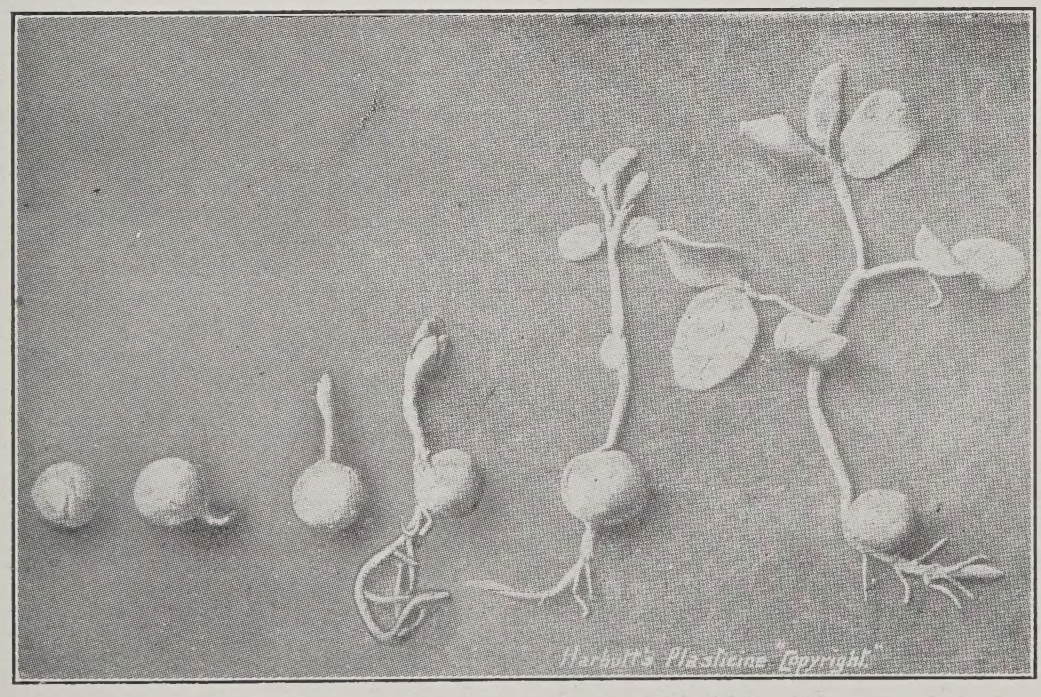


Plate 1*a*.—Germination of the Pea

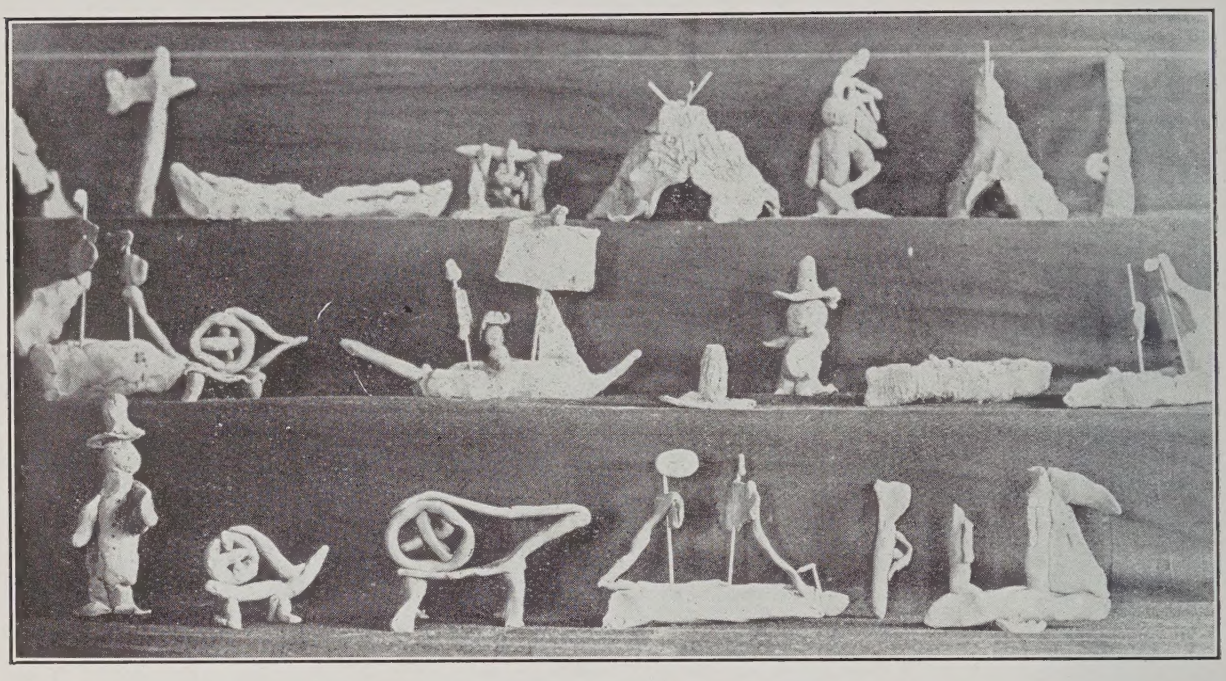


Plate 2.—Plasticine modelling illustrating stories of Indian life and of the Pilgrim Fathers.

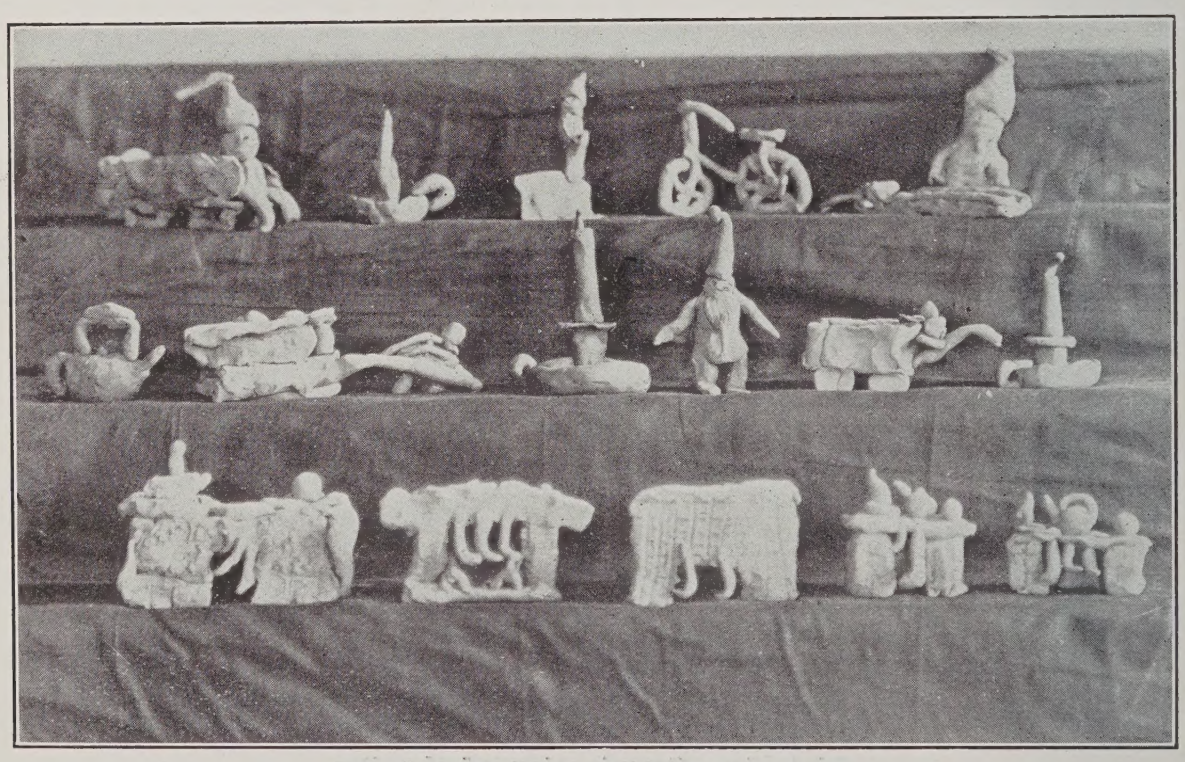


Plate 2*a*.—Plasticine modelling illustrating the Christmas season

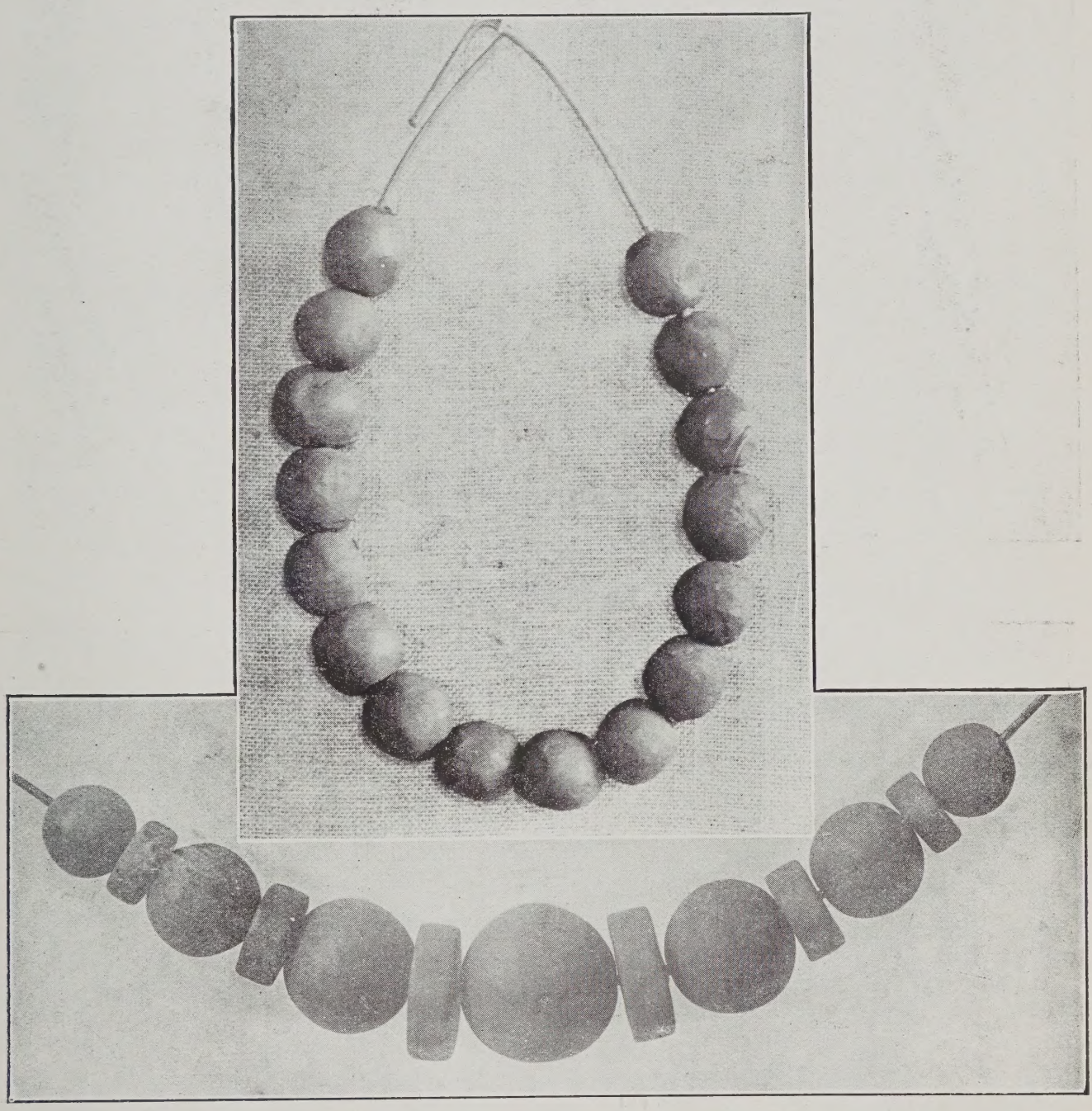


Plate 3.—String of beads and discs in Plasticine

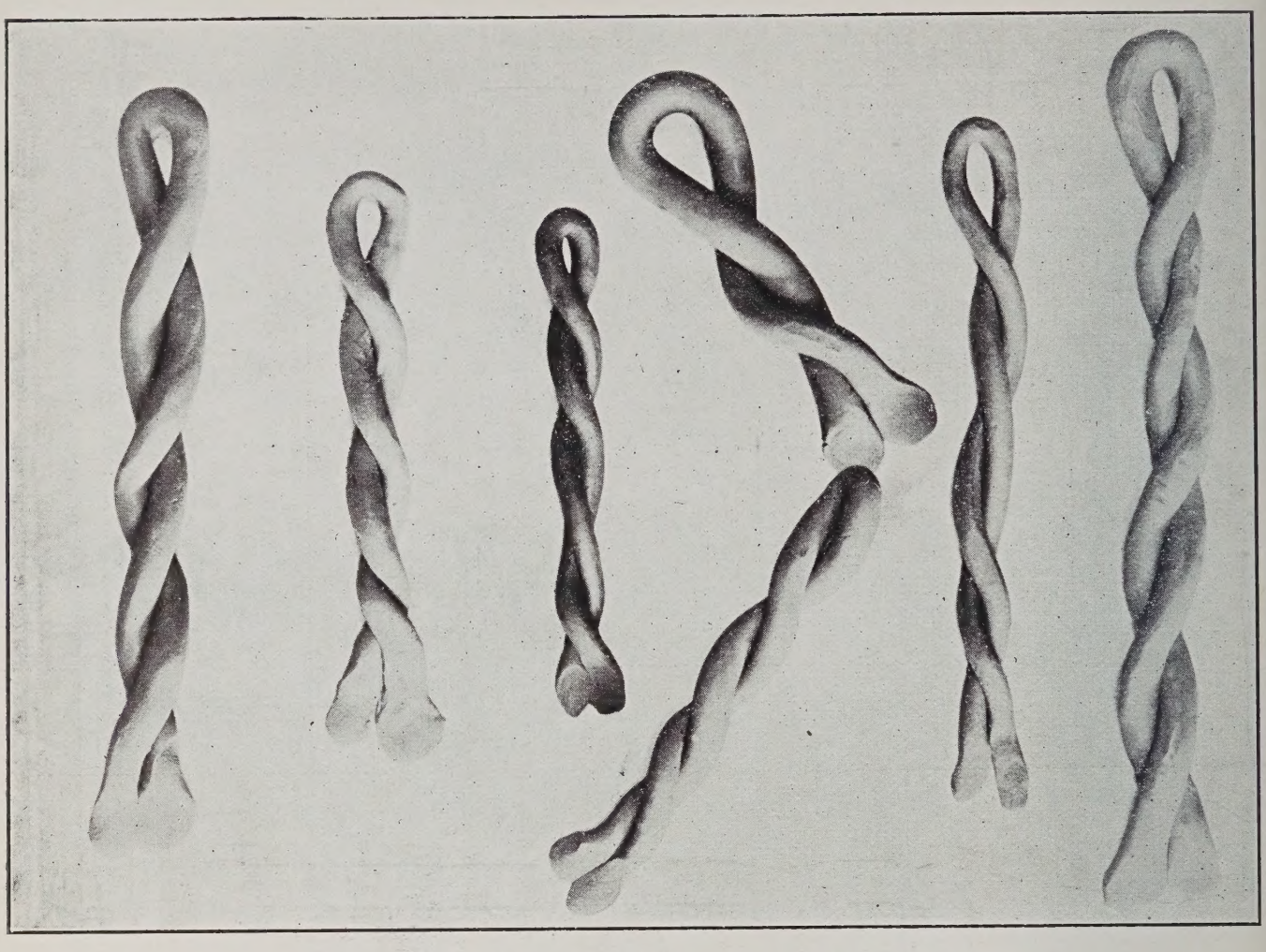


Plate 4.—Rolls and twists made in Plasticine

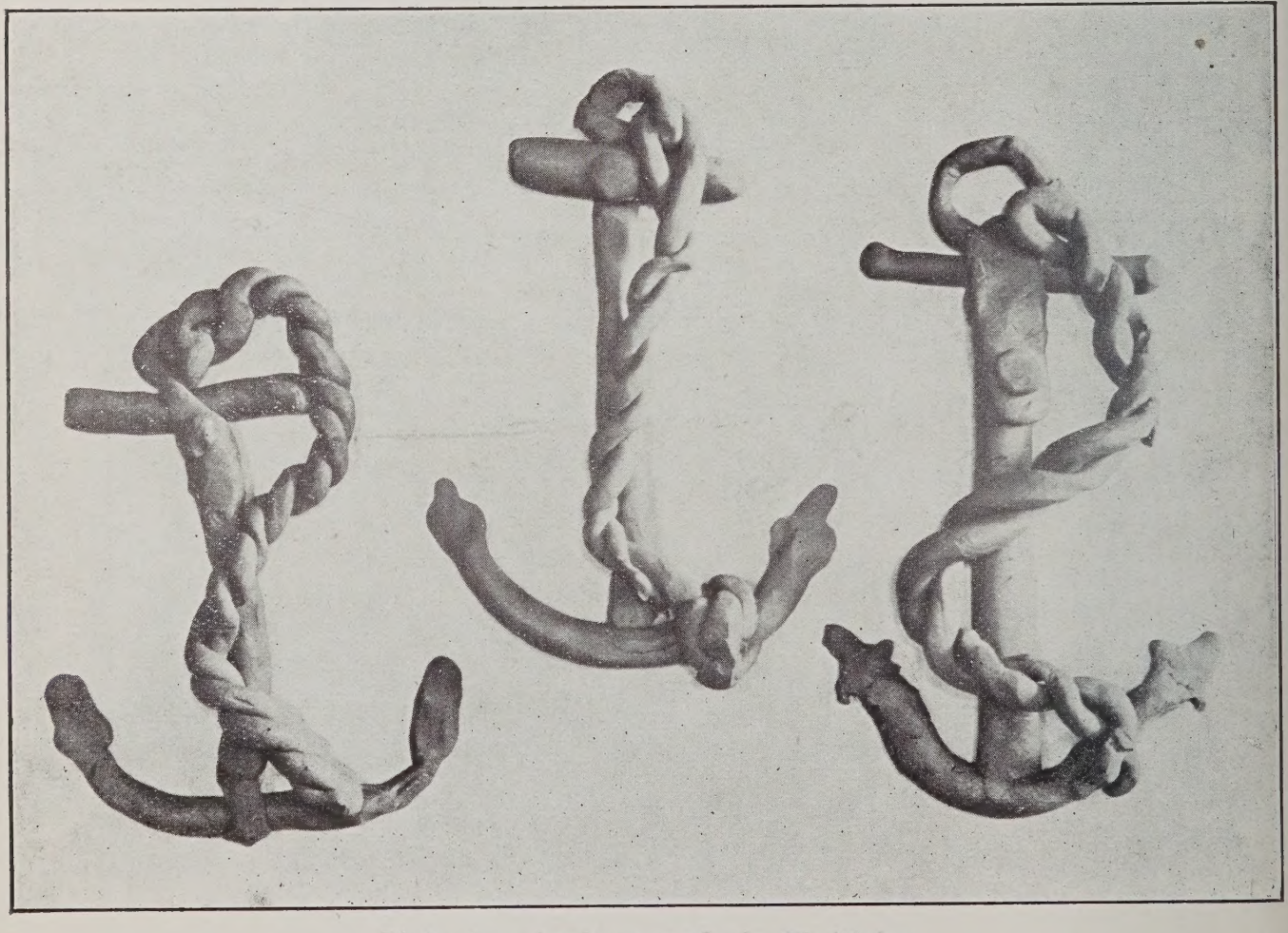


Plate 4*a*.—Anchors made in Plasticine

Plate 5.—Border designs in Plasticine

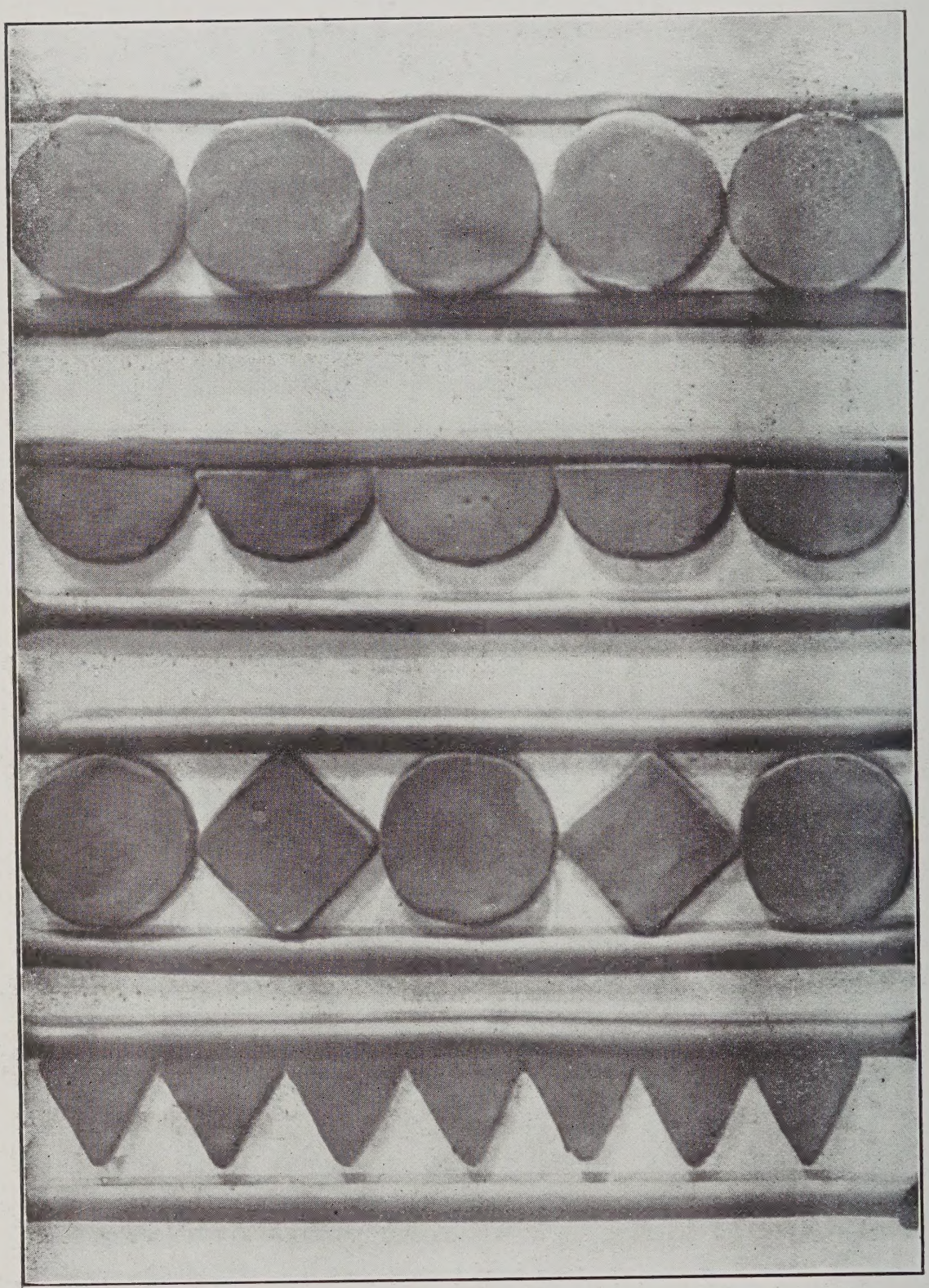


Plate 6.—Border designs composed of shapes cut from Plasticine

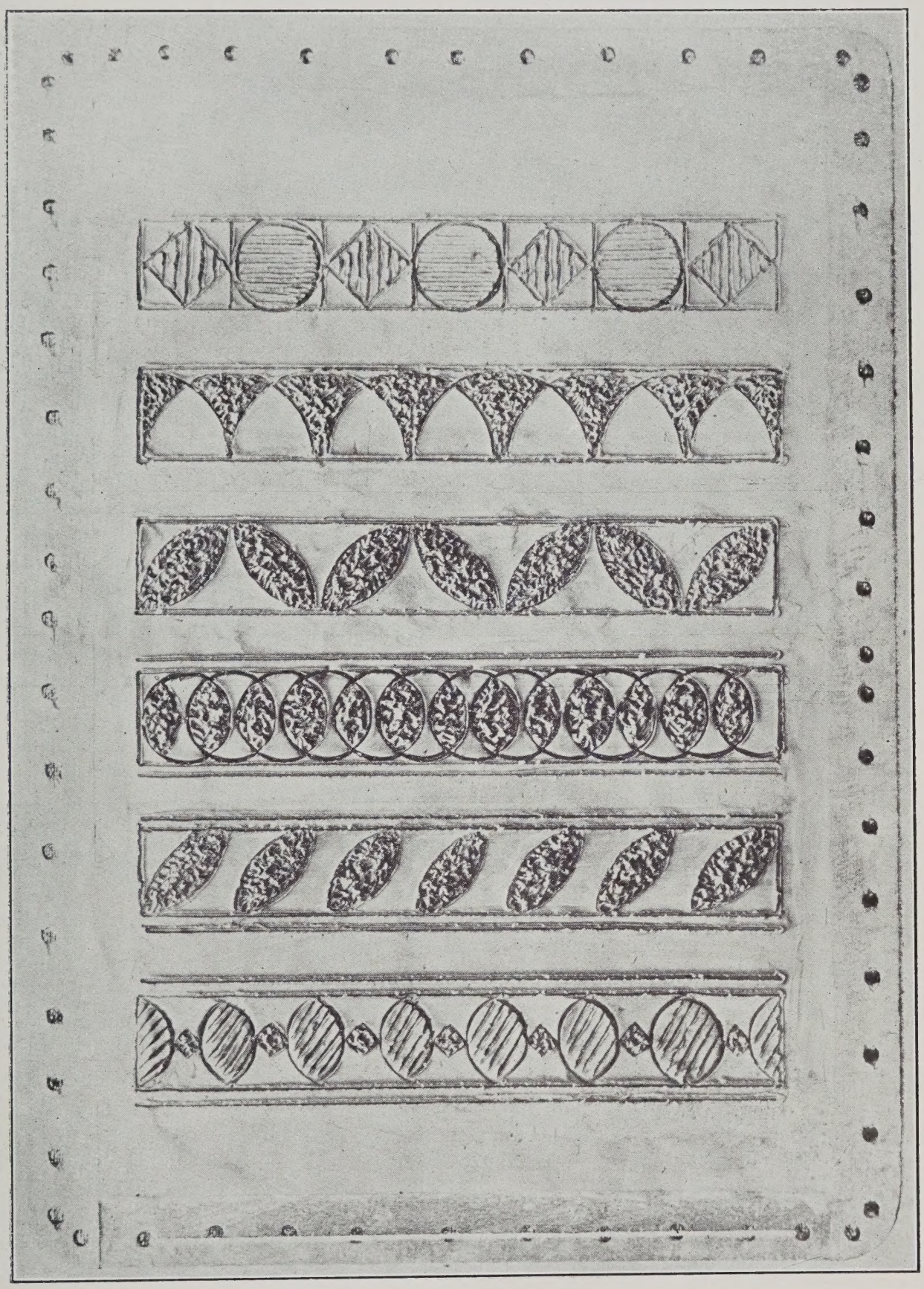


Plate 7.—Border patterns drawn on a slate filled in with Plasticine

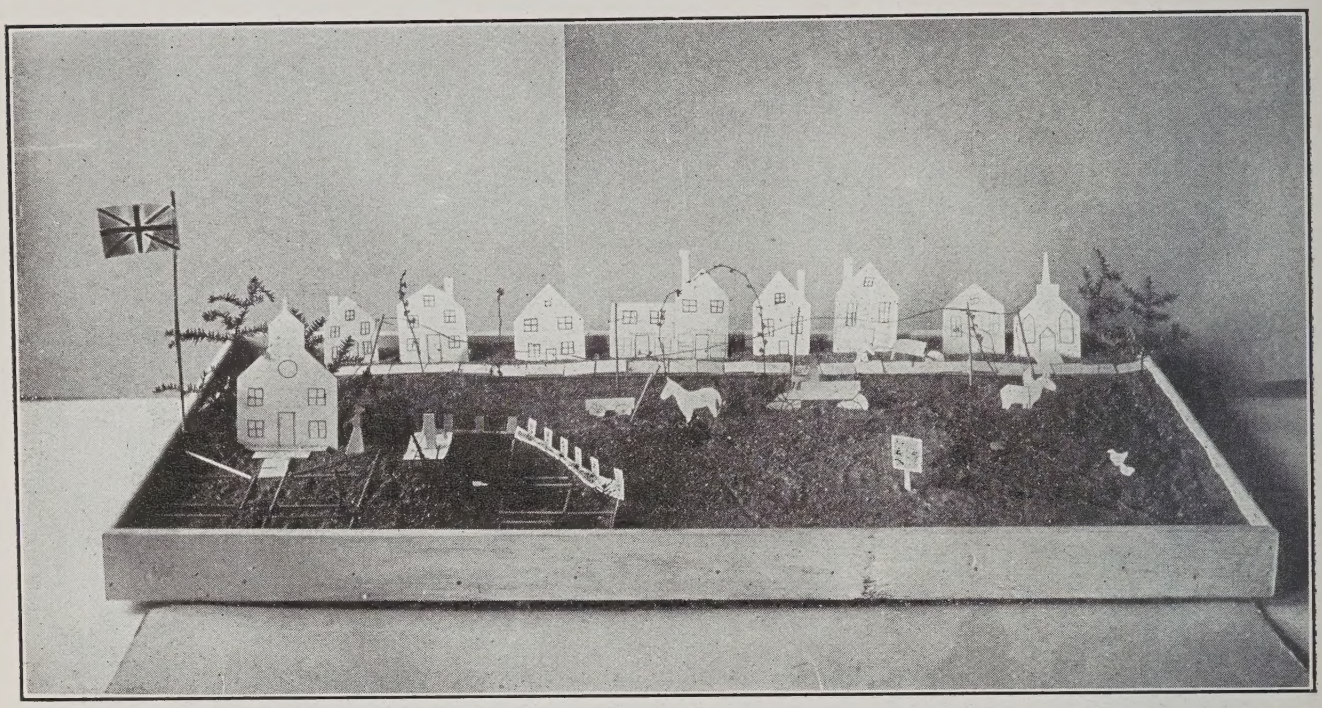


Plate 8.—Primary sand table work

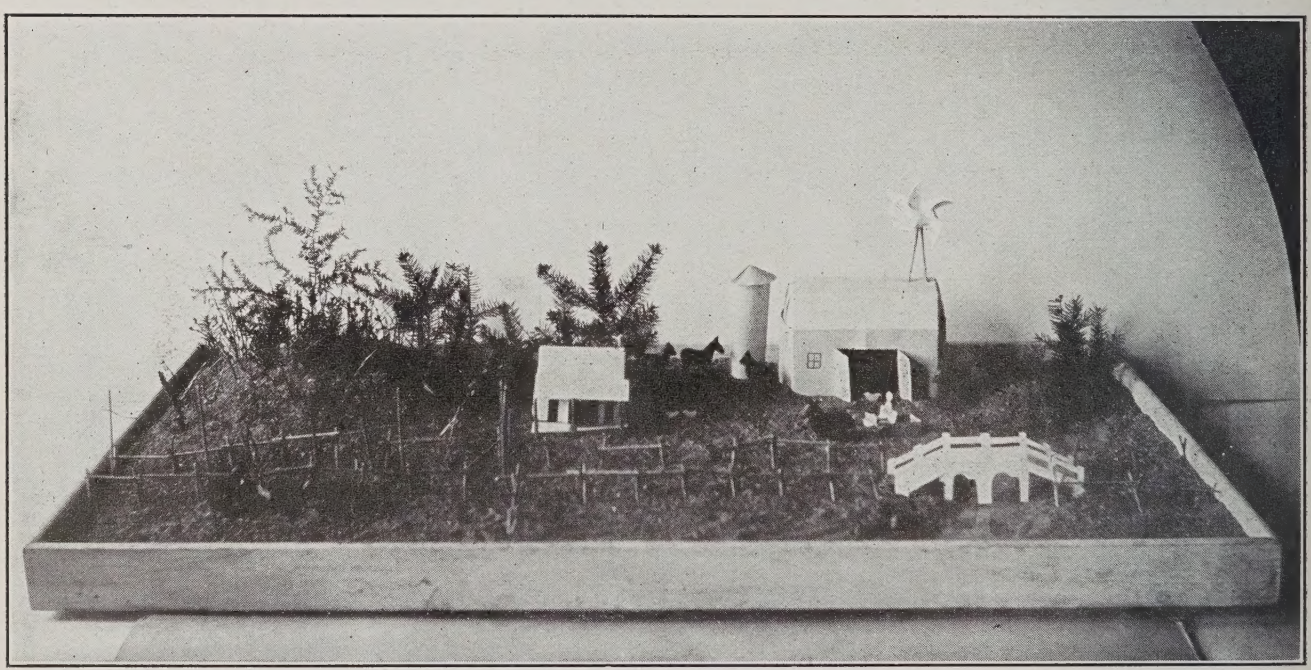


Plate 8a.—Advanced sand table work

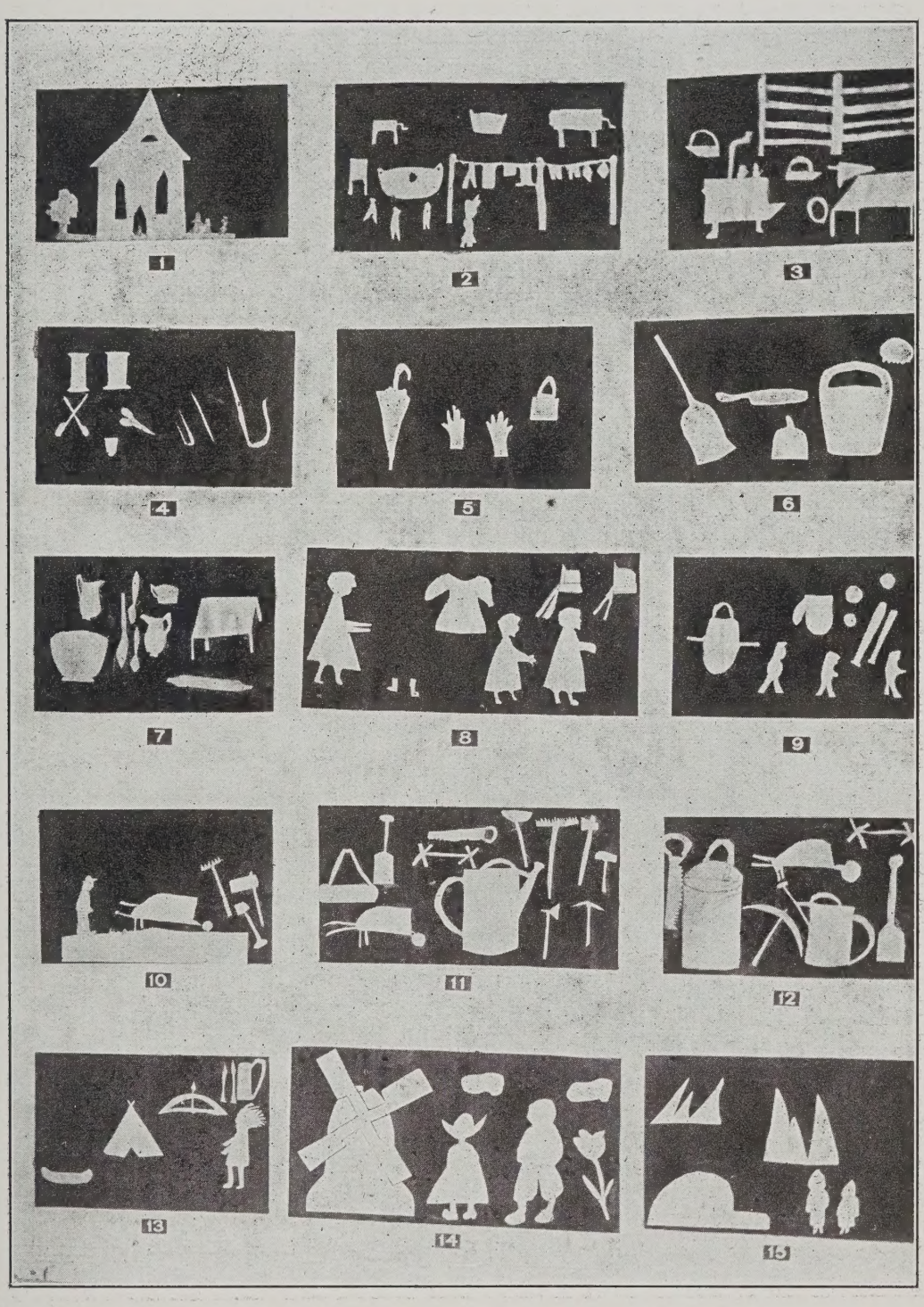


Plate 9.—Illustrative paper cuttings

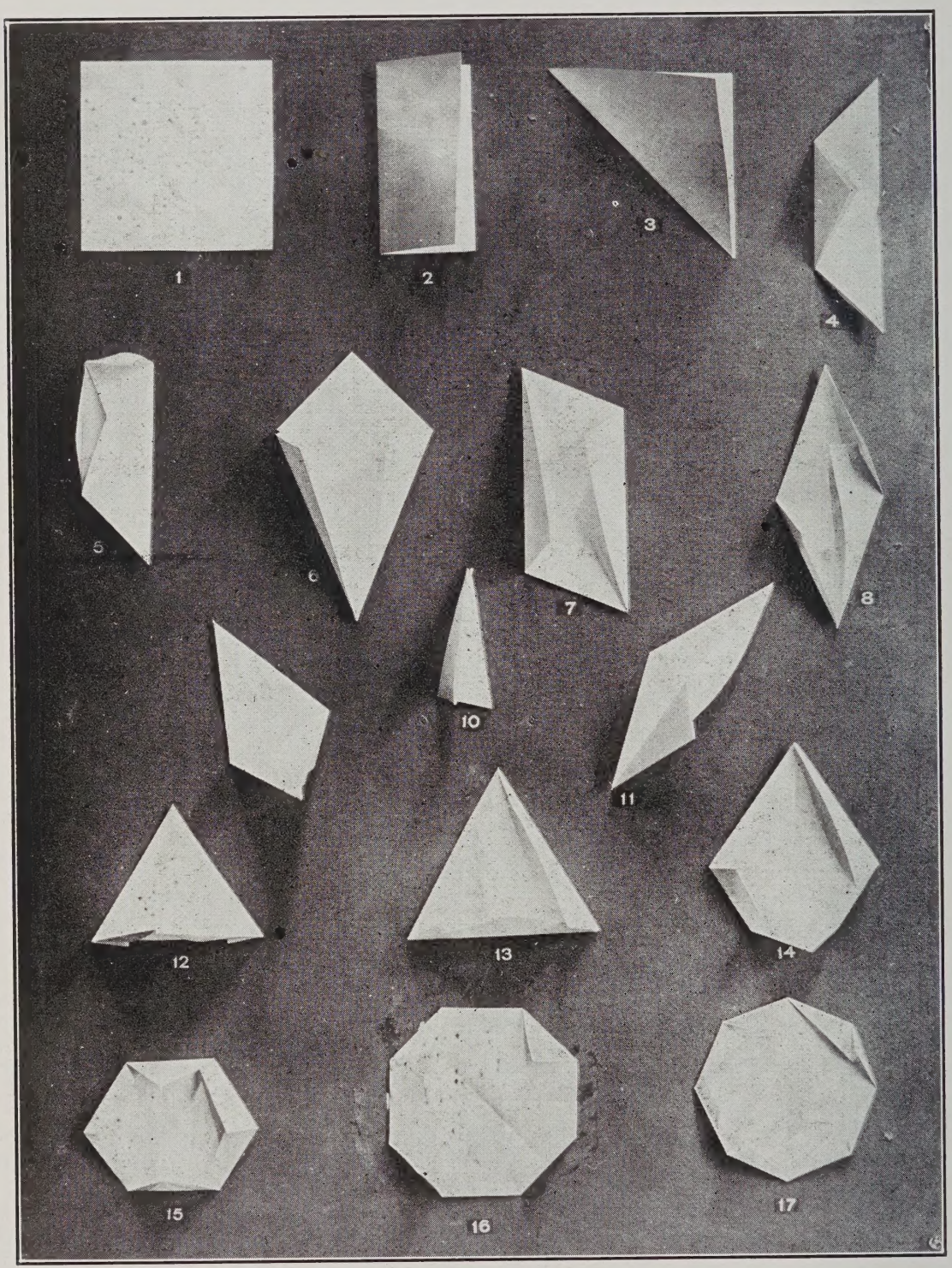


Plate 10.—Geometric paper folding

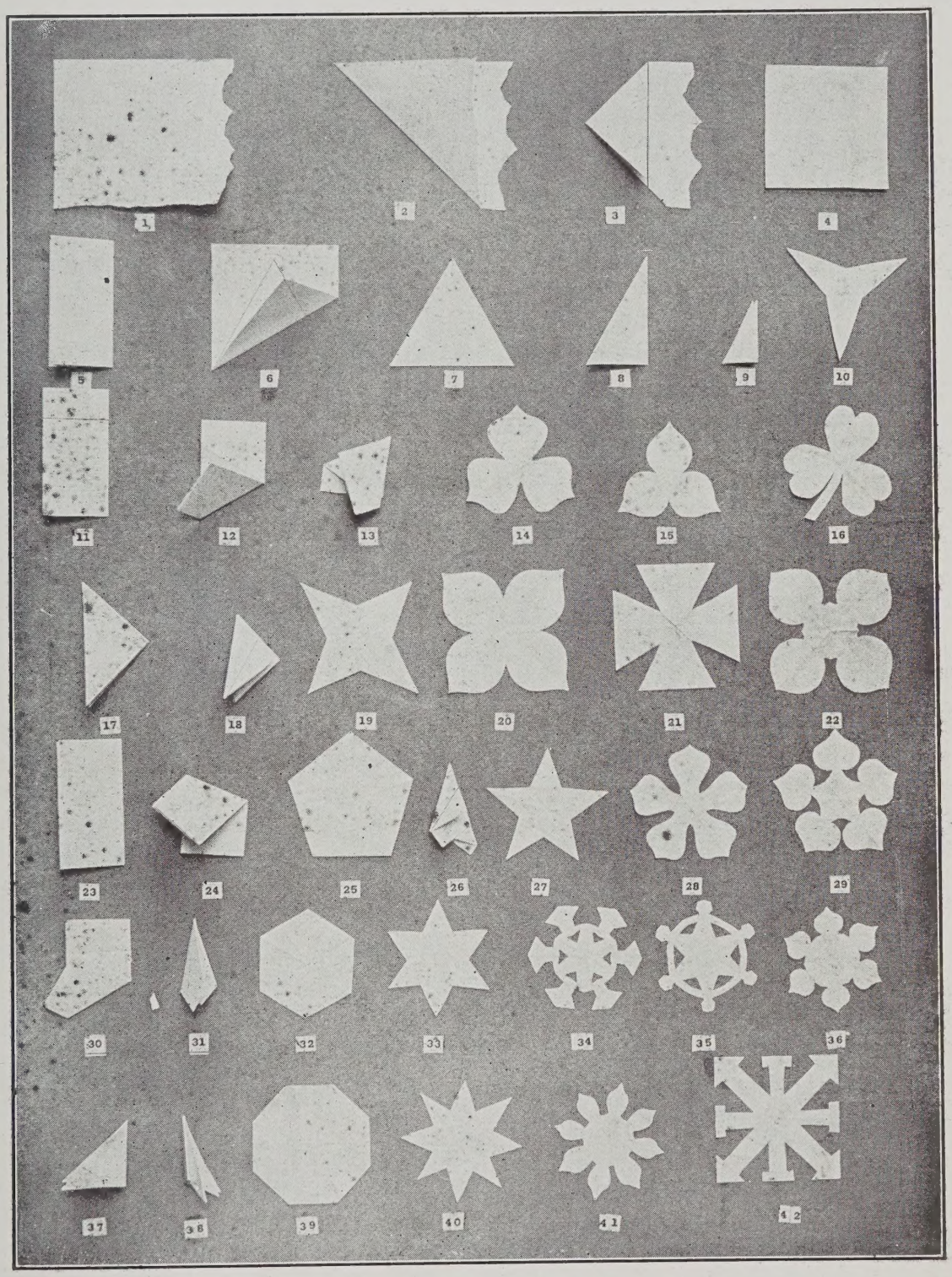


Plate 11.—Folding and cutting Geometric Forms

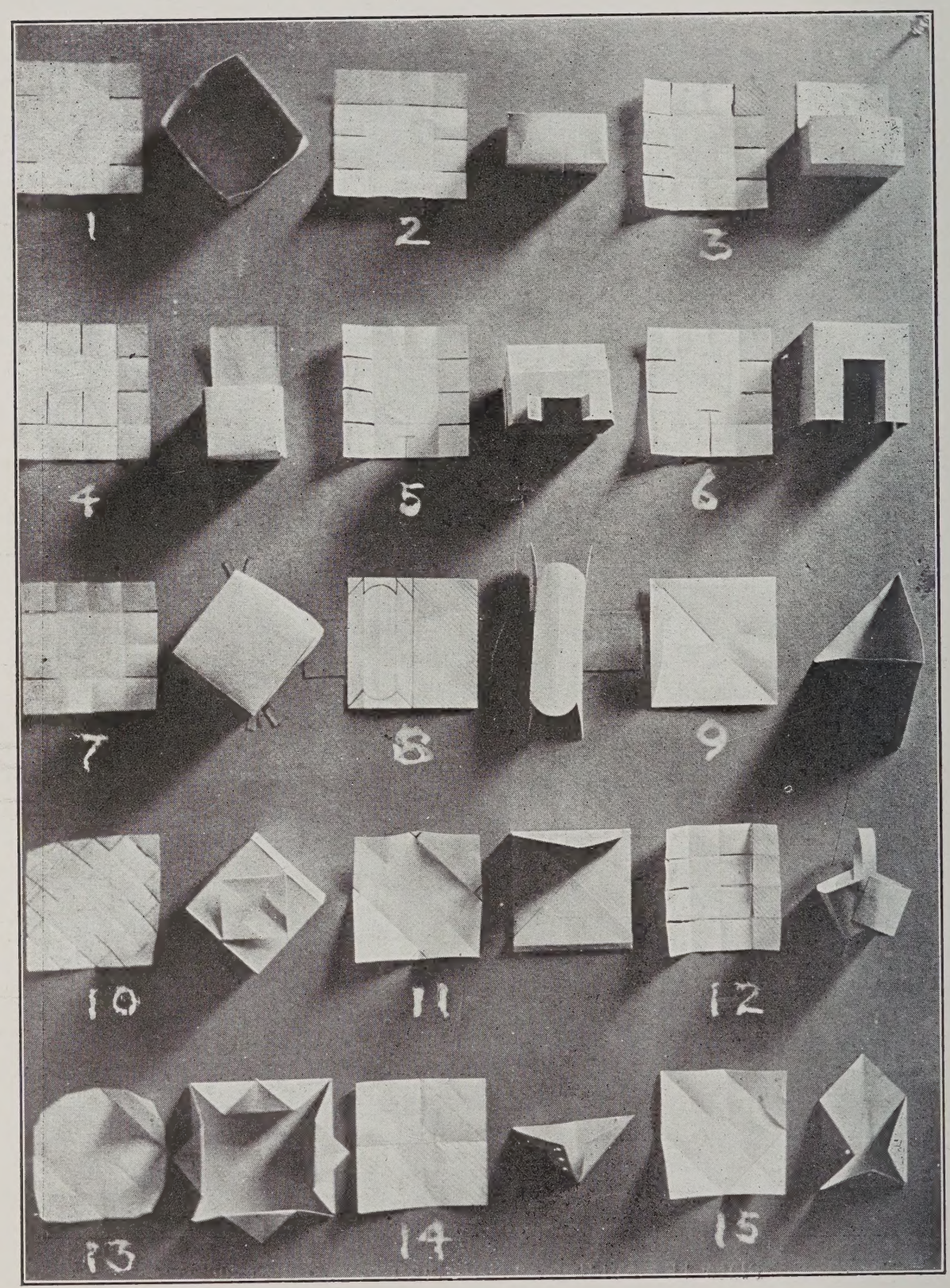


Plate 12.—Constructive work in paper

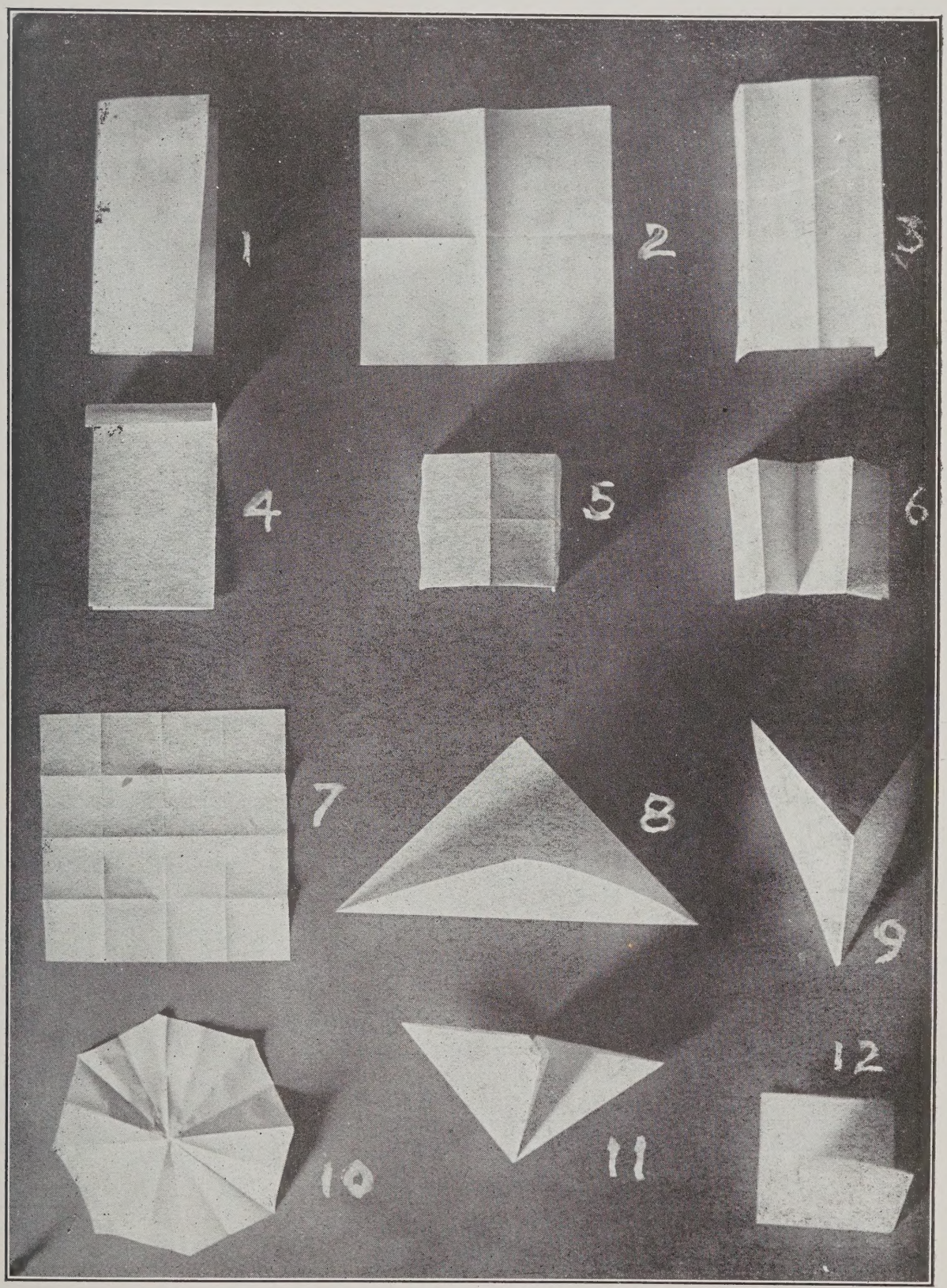


Plate 13.—Simple paper folding

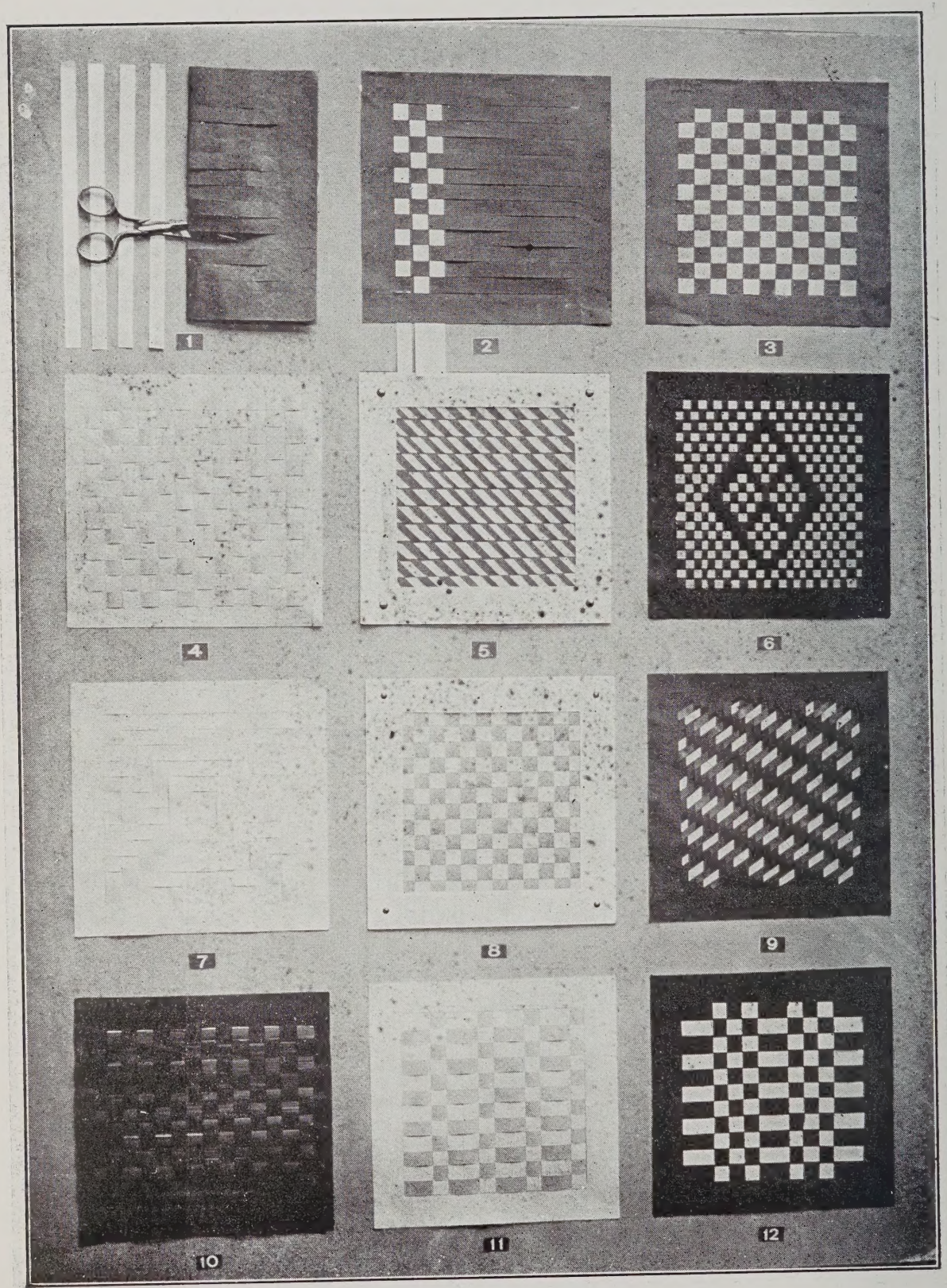


Plate 14.—Paper weaving

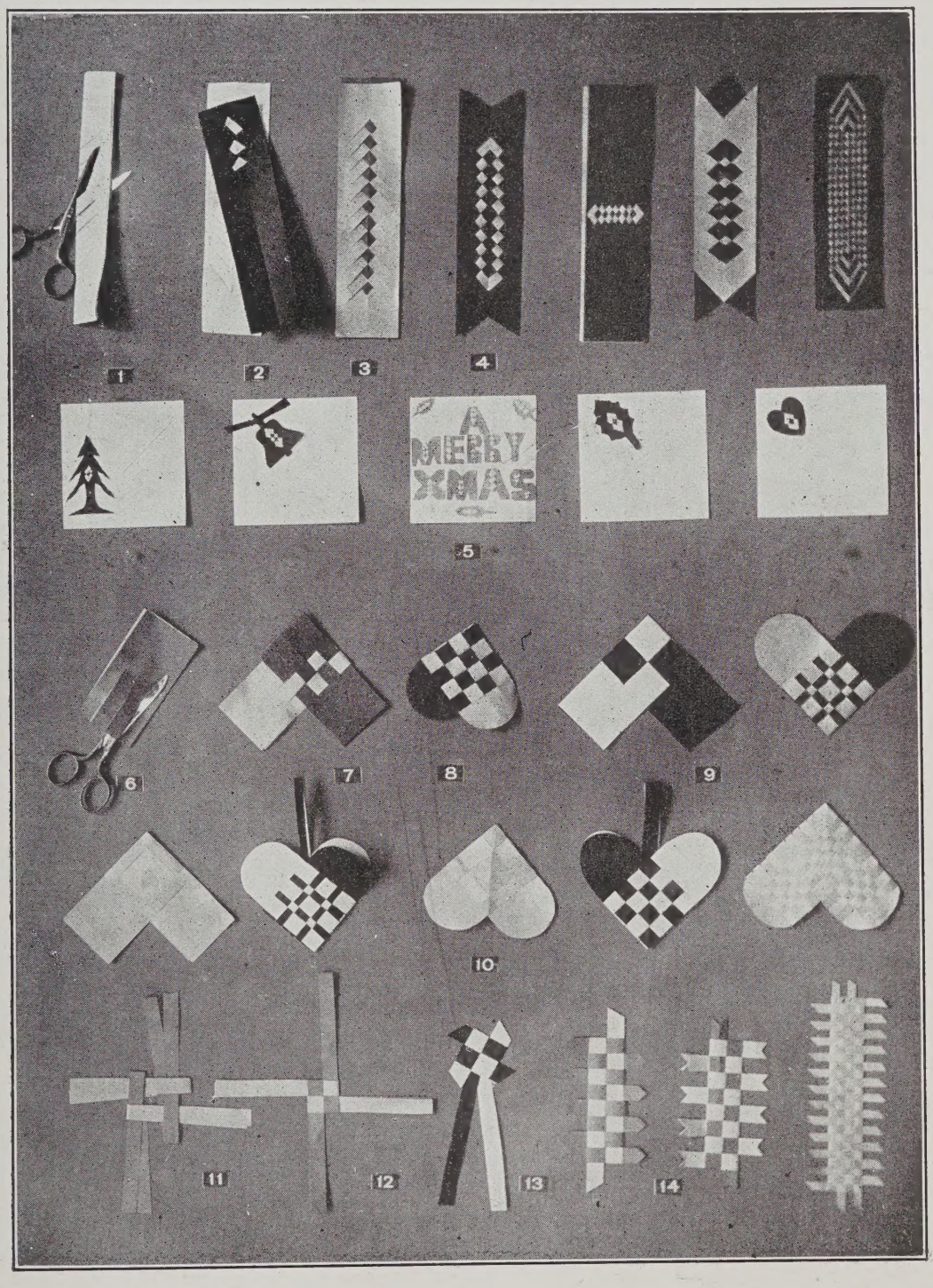
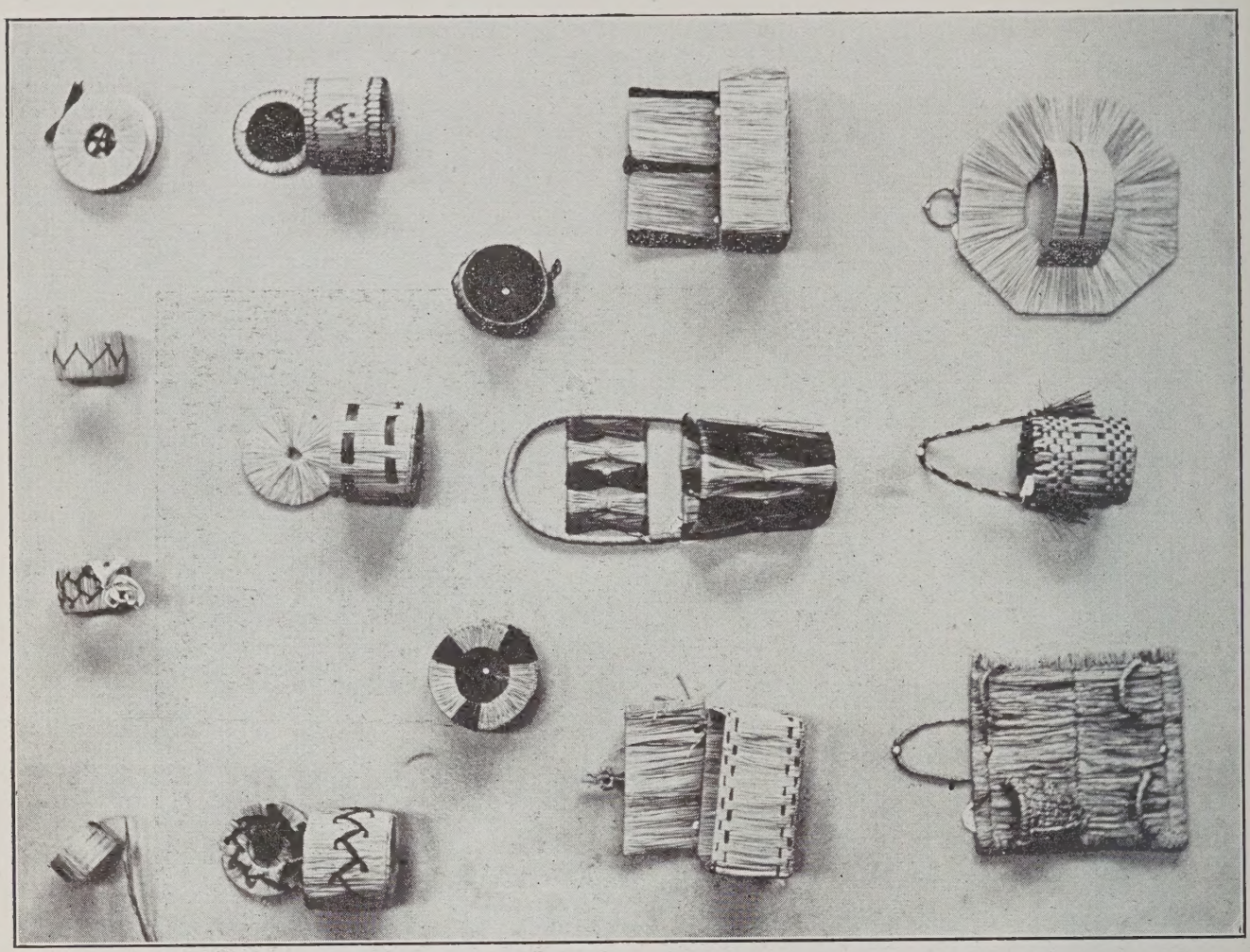


Plate 15.—Application of paper weaving



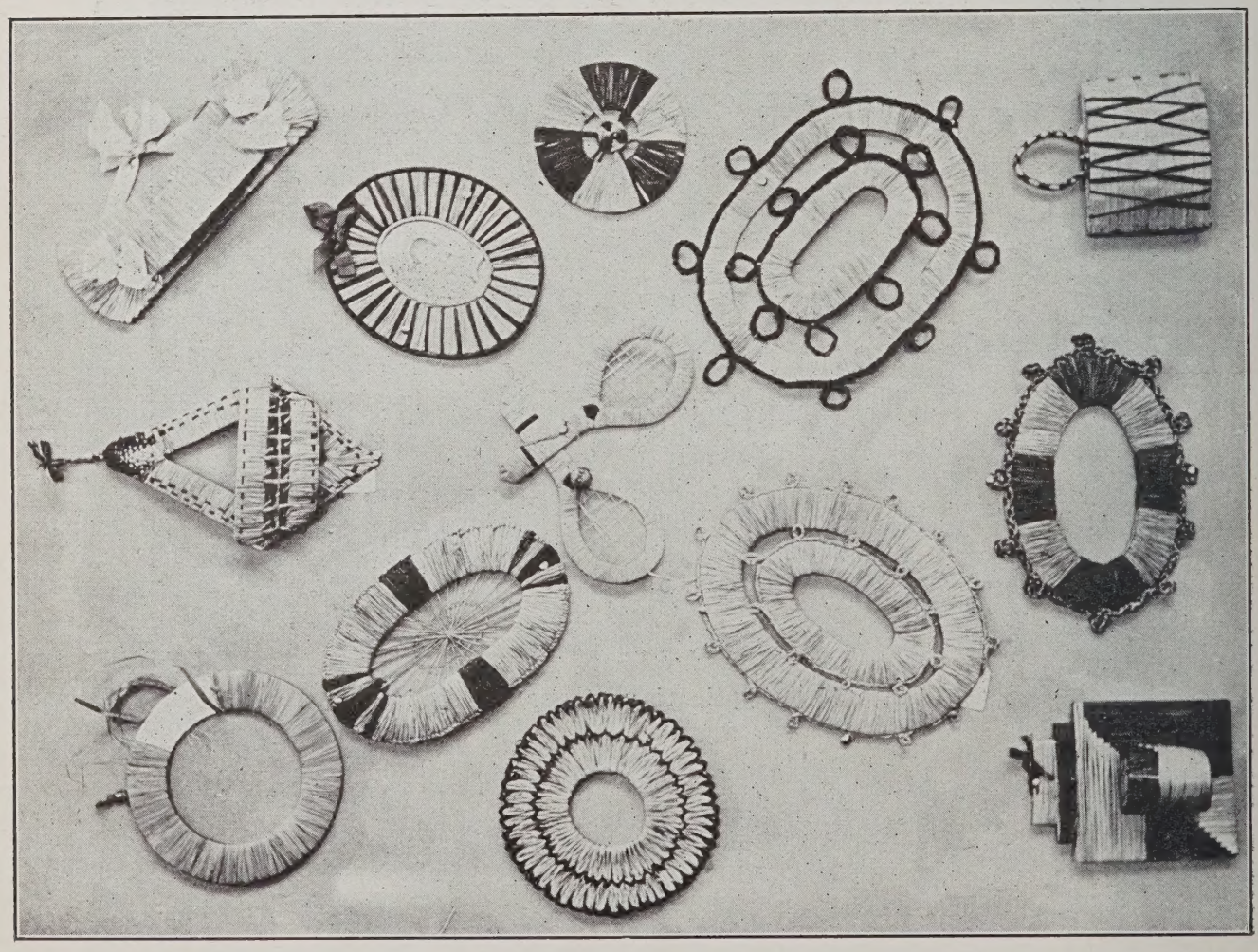


Plate 16.—Winding or wrapping

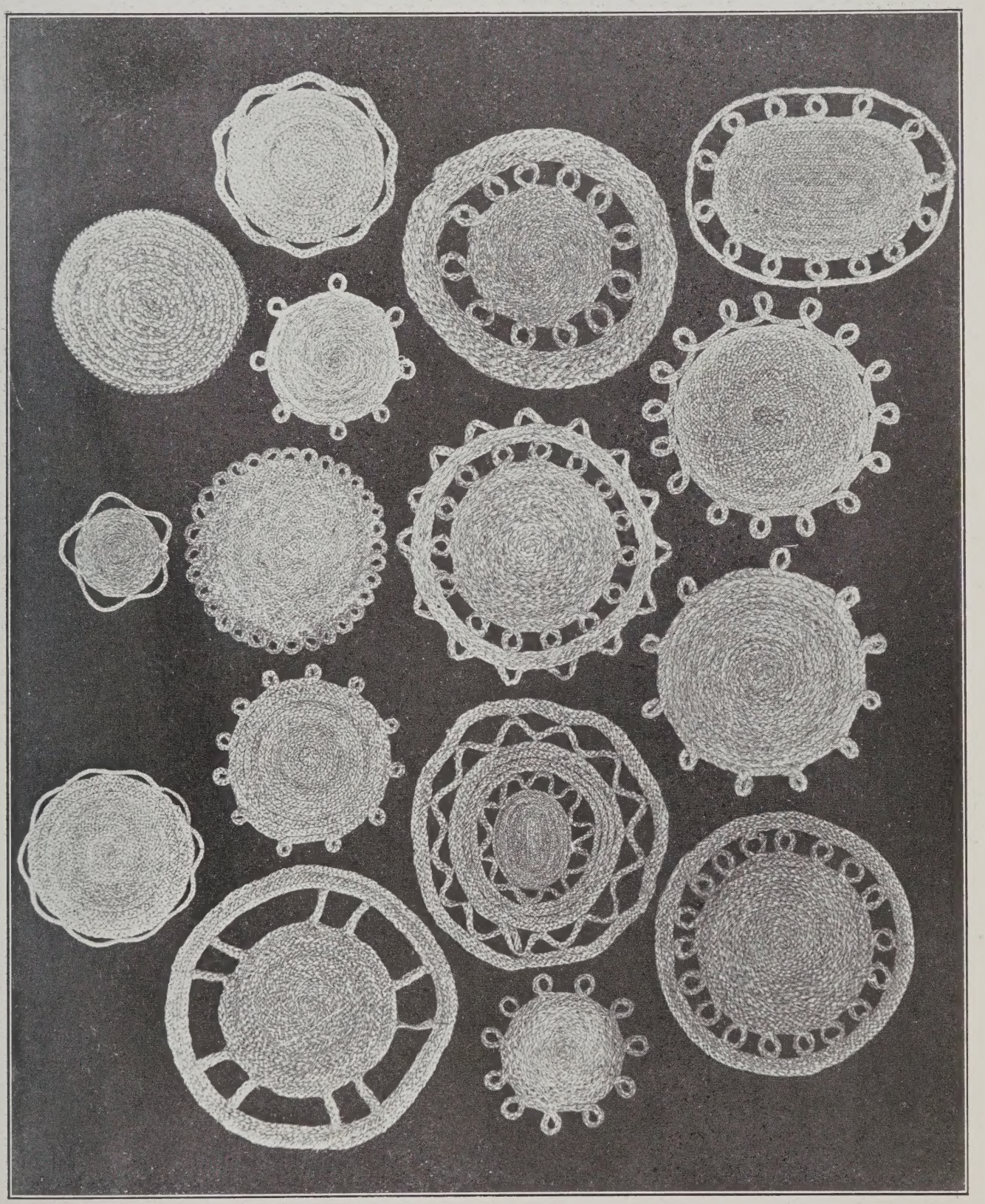


Plate 17.—Braided mats—Raffia

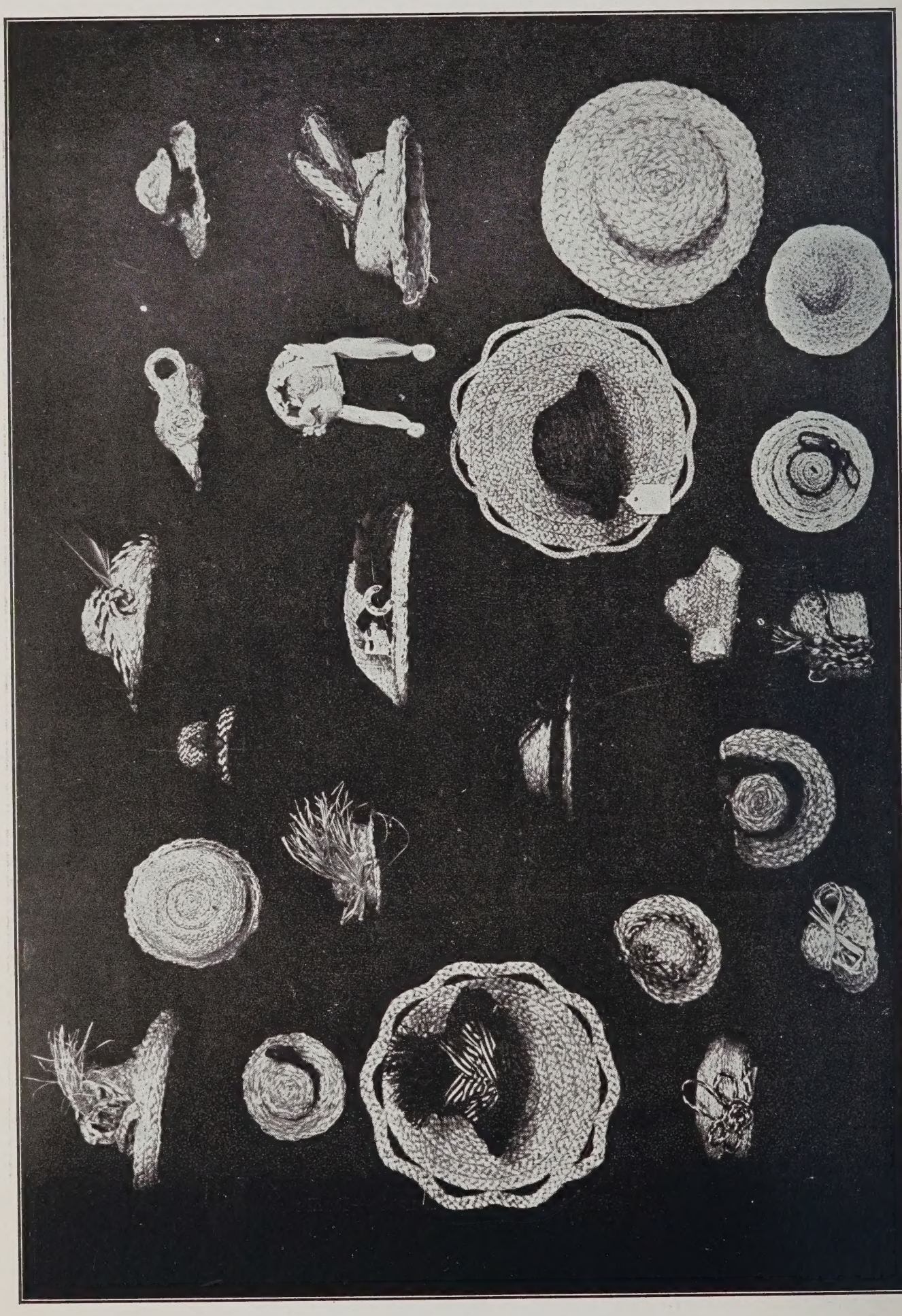


Plate 18.—Braided hats

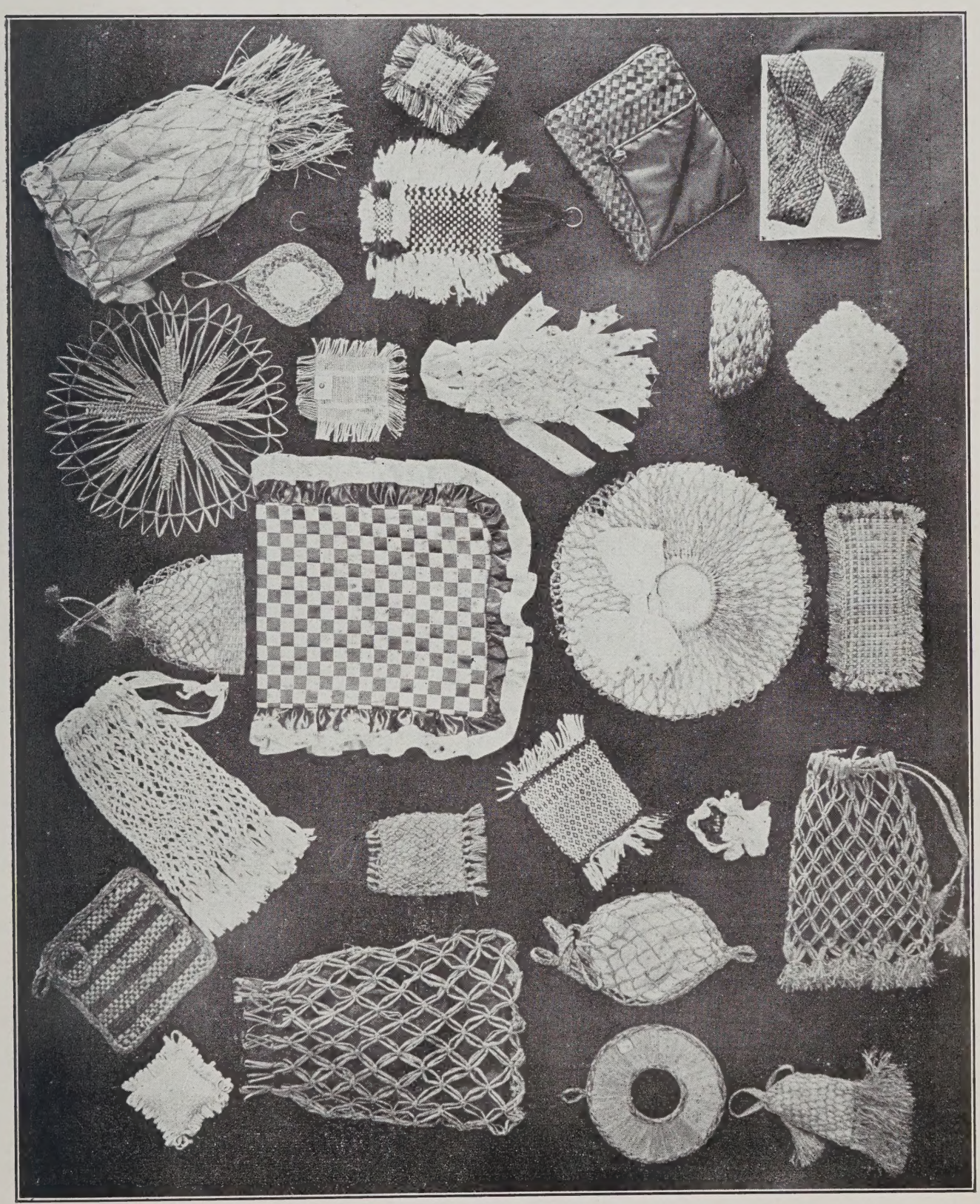


Plate 19.—Braiding and knotting

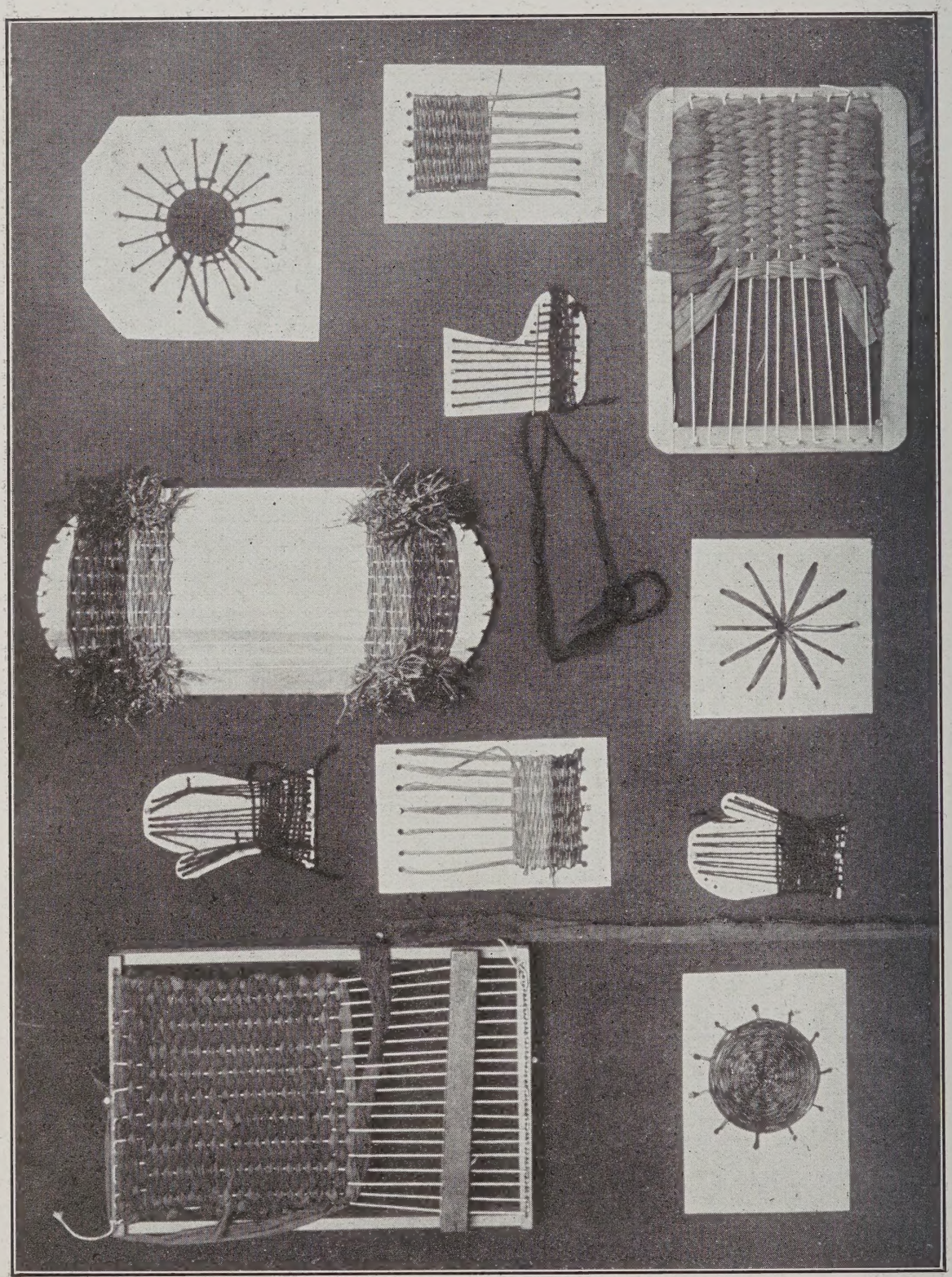


Plate 20.—Various looms

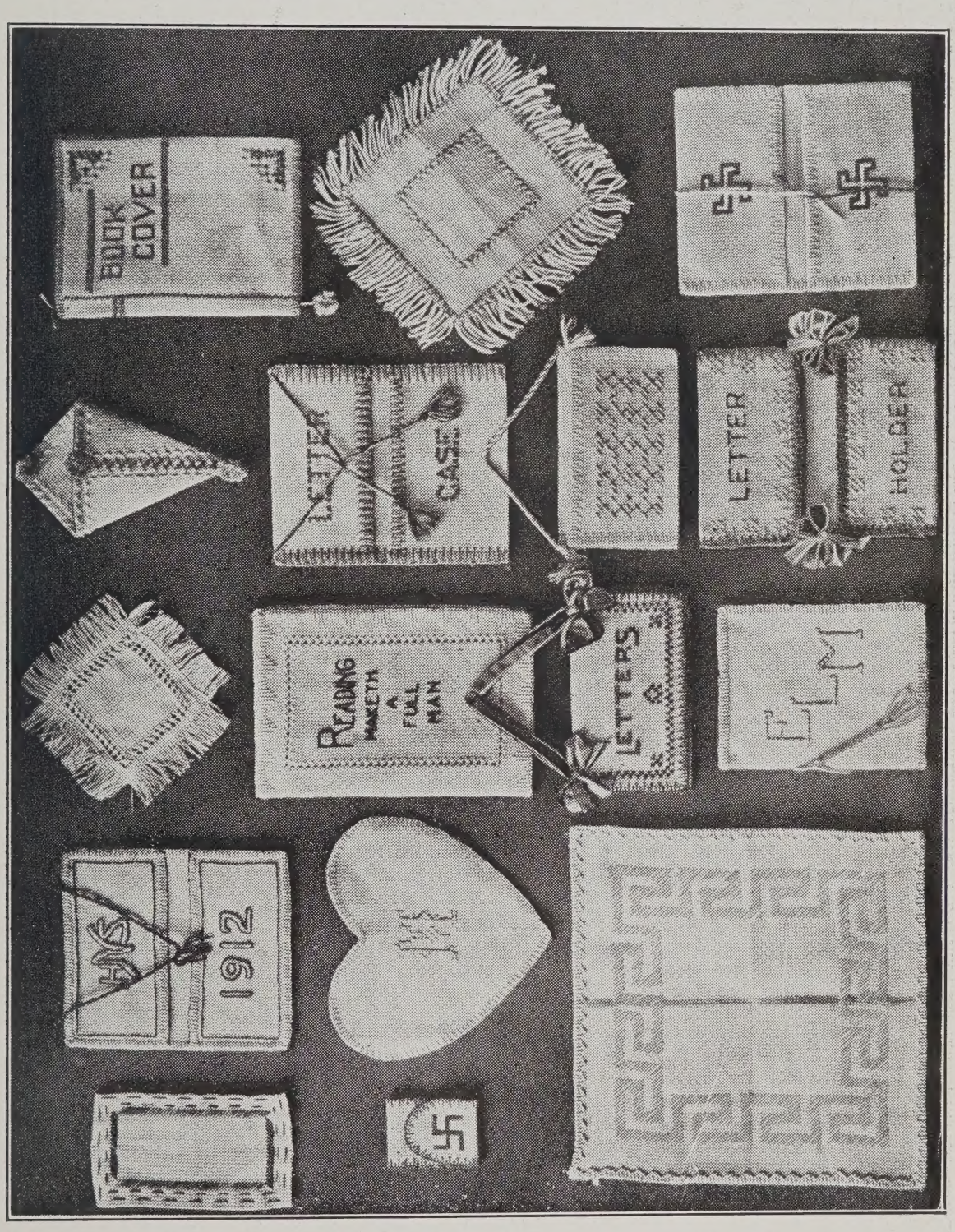


Plate 21.—Work in wool or raffia on canvas

Plate 22.—Nature Study—Clay or Plasticine

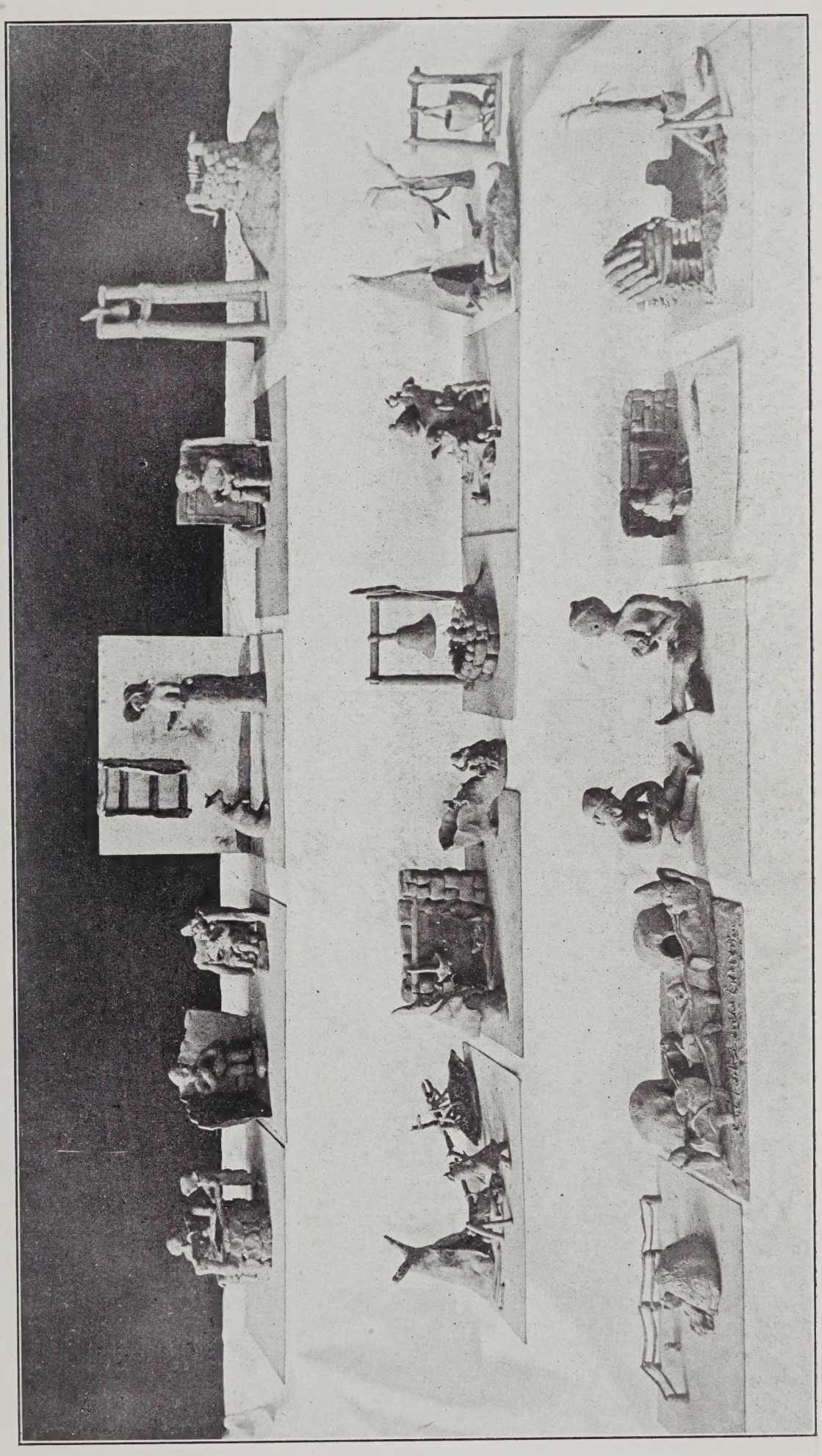


Plate 23.—Stories illustrated in Plasticine

Plate 24.—Stories illustrated in Plasticine

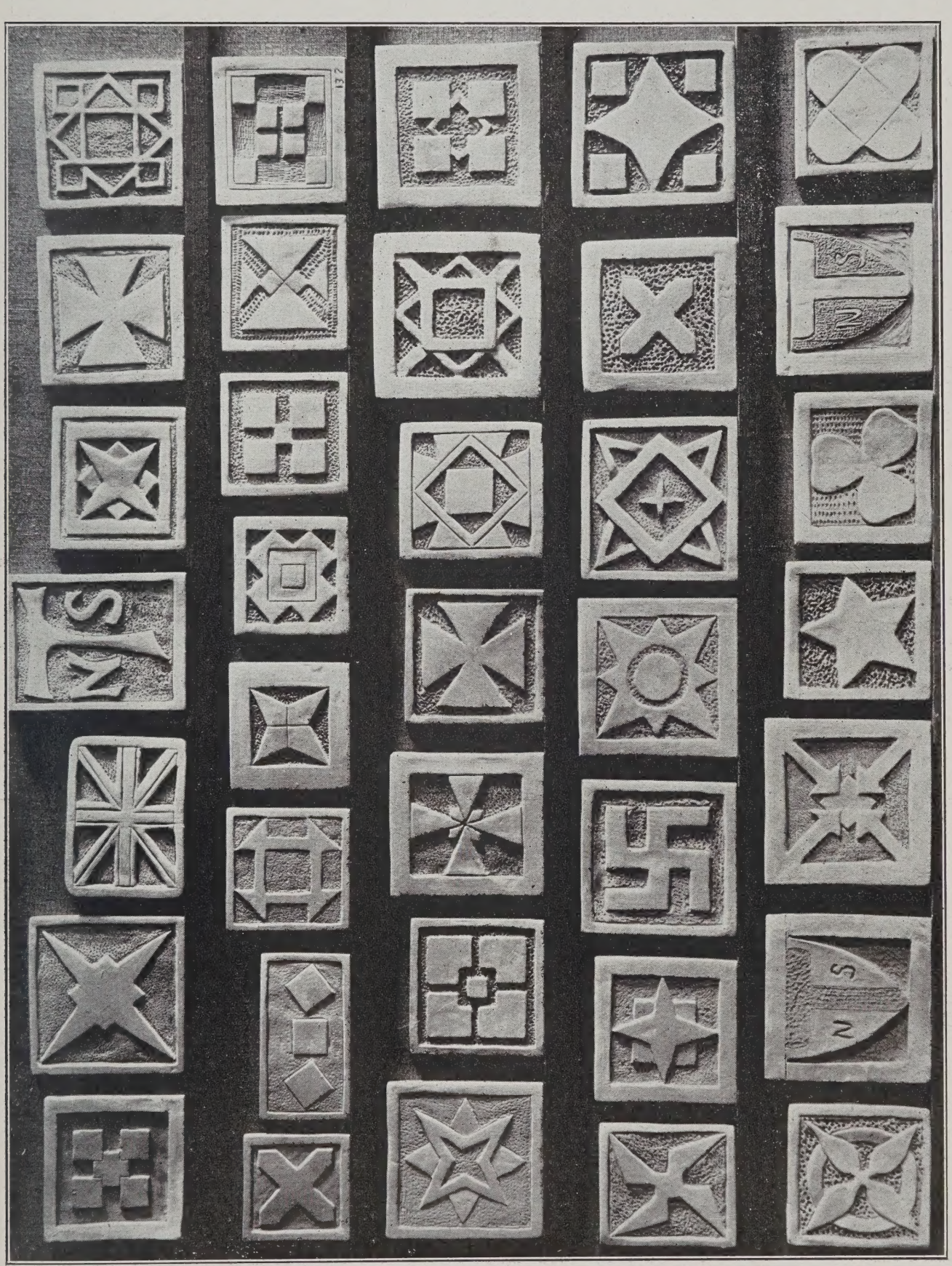


Plate 25.—Tiles

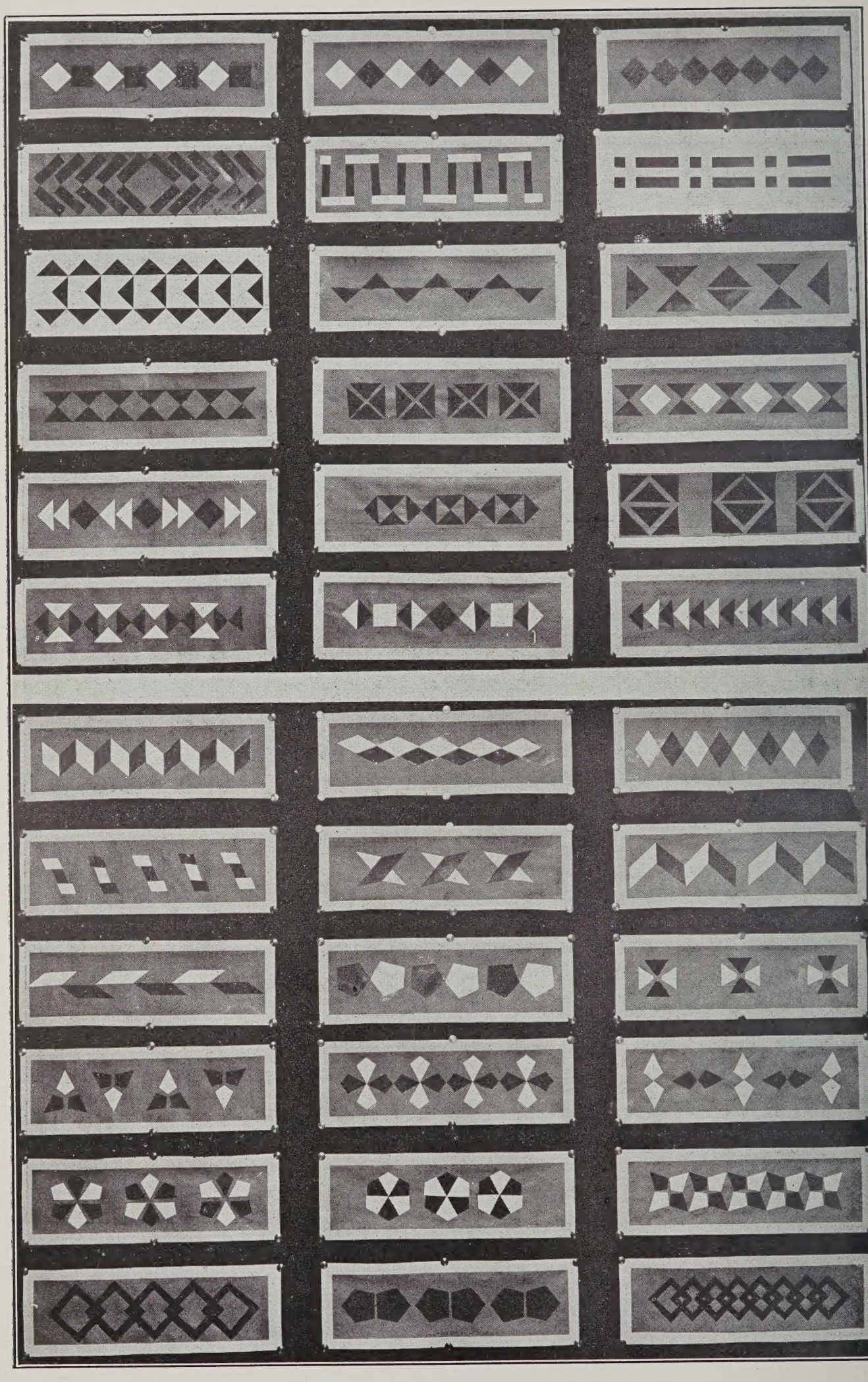


Plate 26.—Borders formed from geometrical units

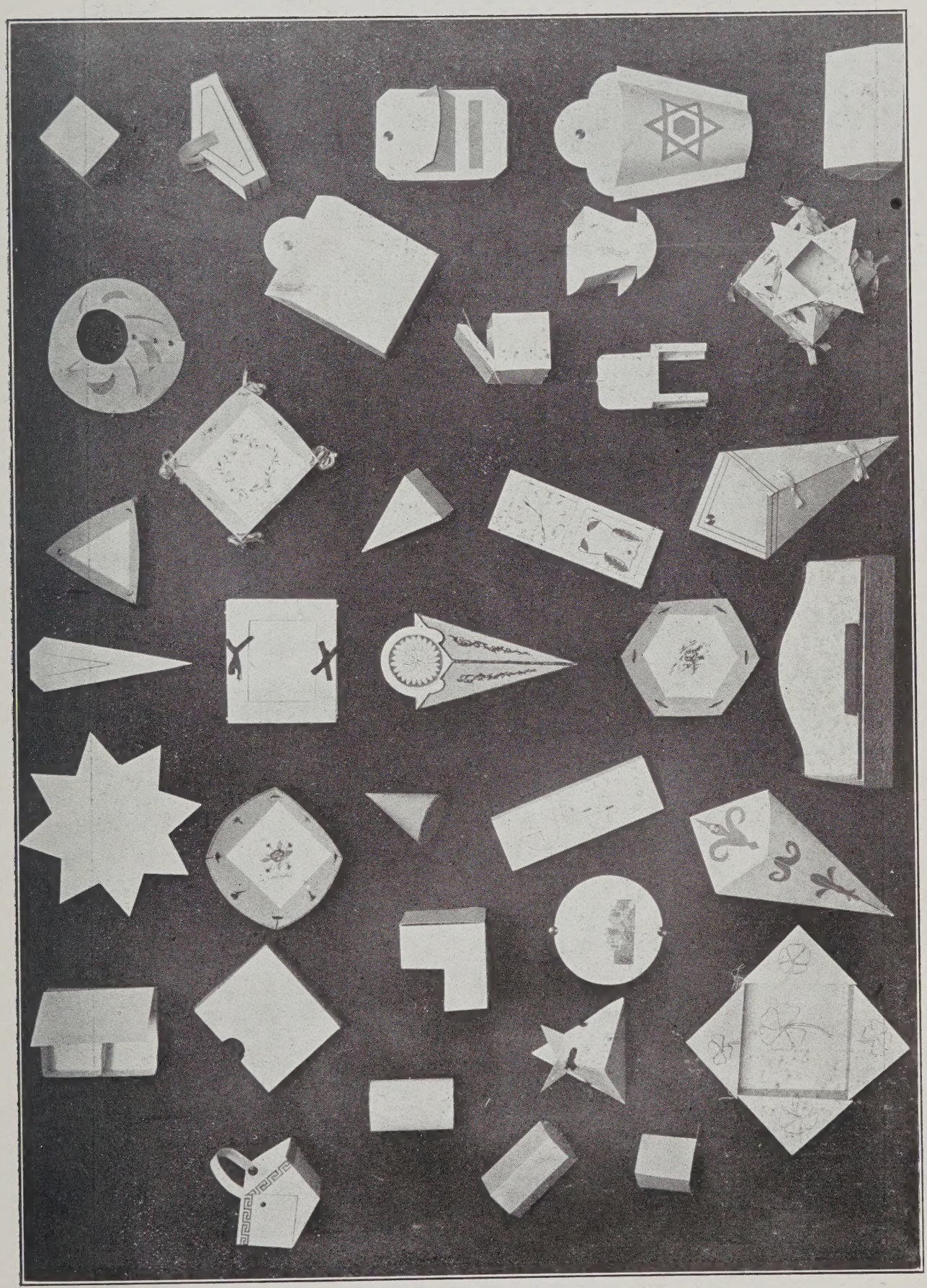


Plate 27.—Cardboard models

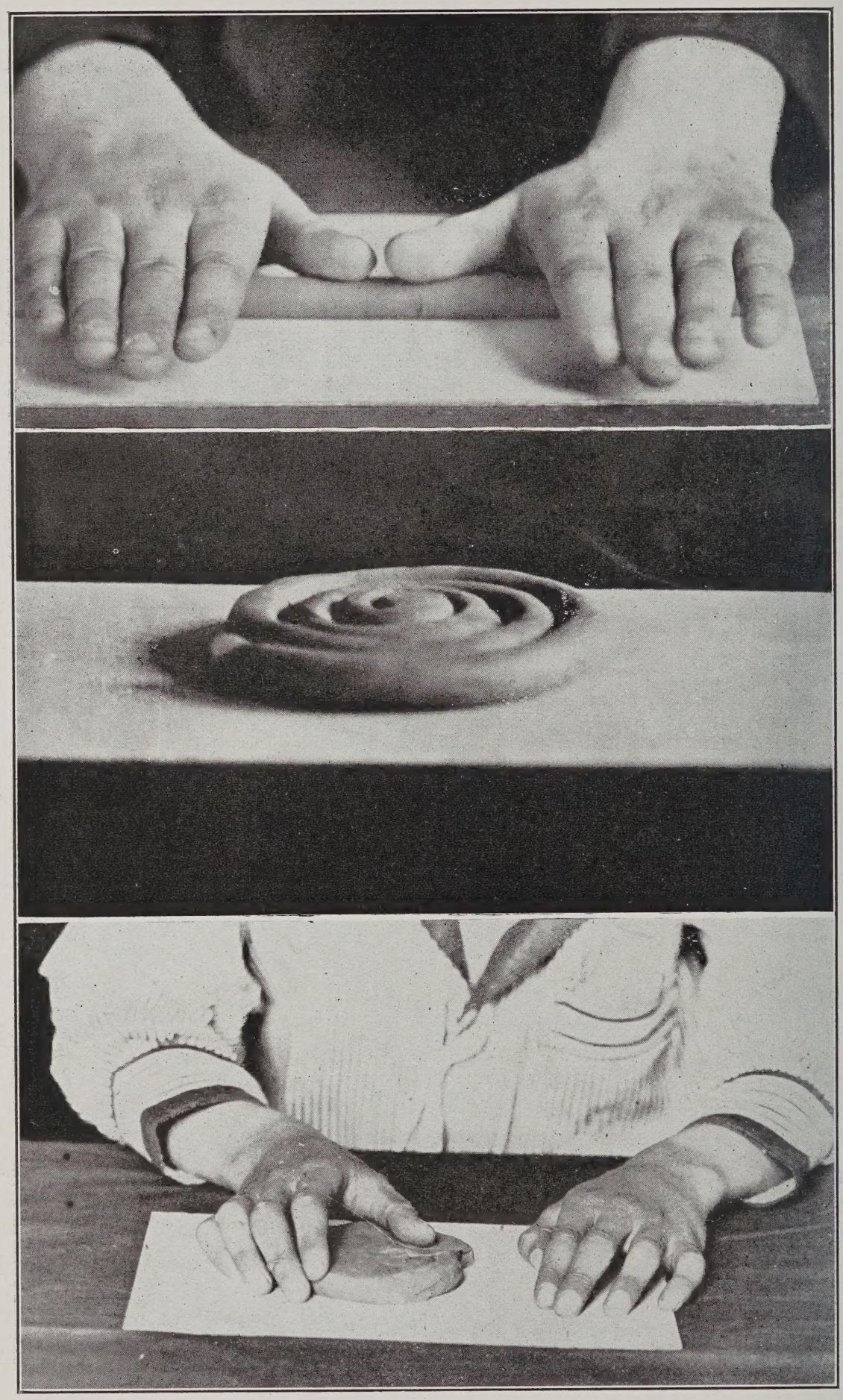


Plate 28.—1. Making a roll of clay to form a base 2. The coil
3. Making a base from the coil

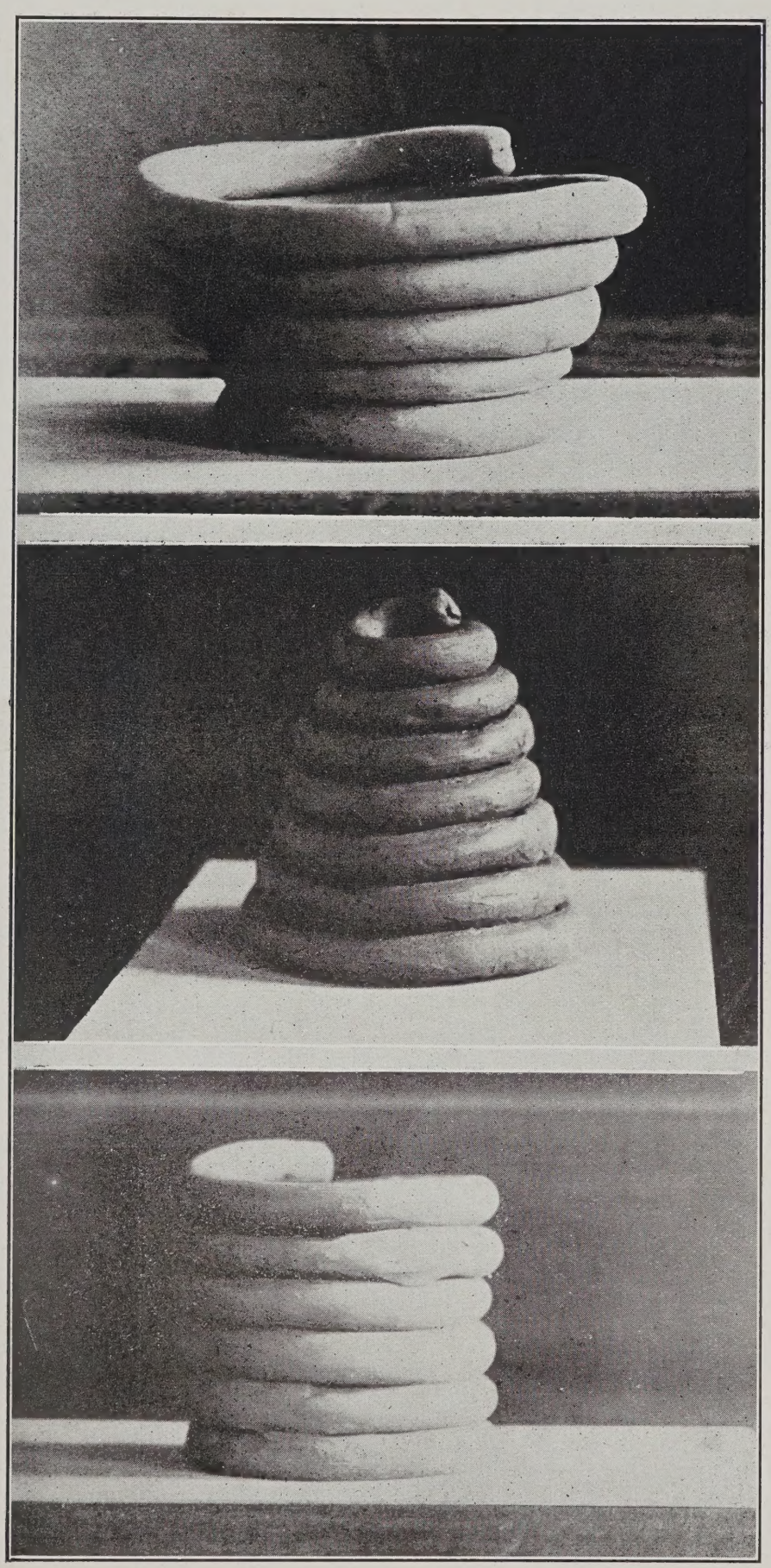


Plate 29.—(1) Increasing and (2) diminishing the sides of a vessel

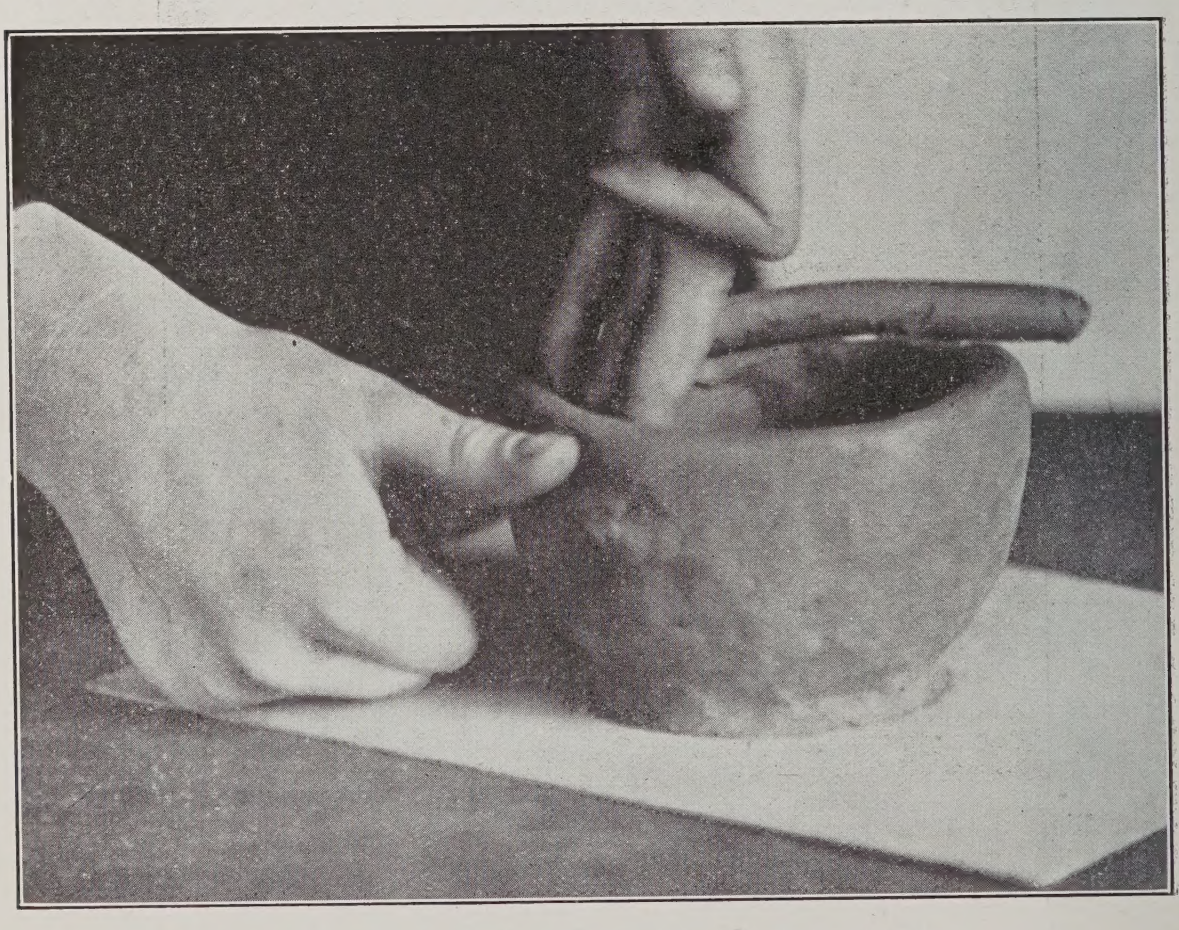


Plate 30.—Position of hands when modelling a vase

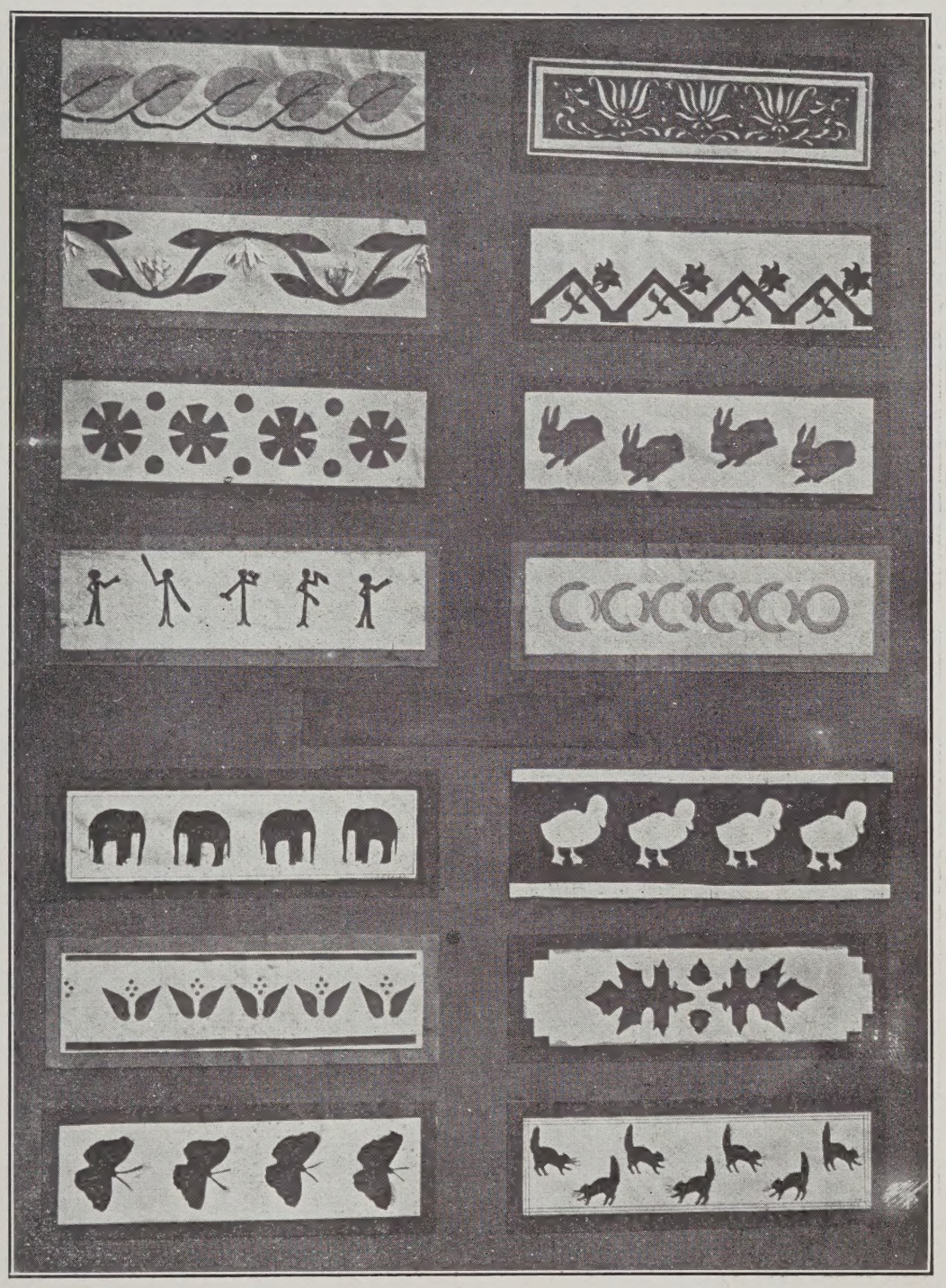


Plate 31.—Paper cuttings used for designing borders

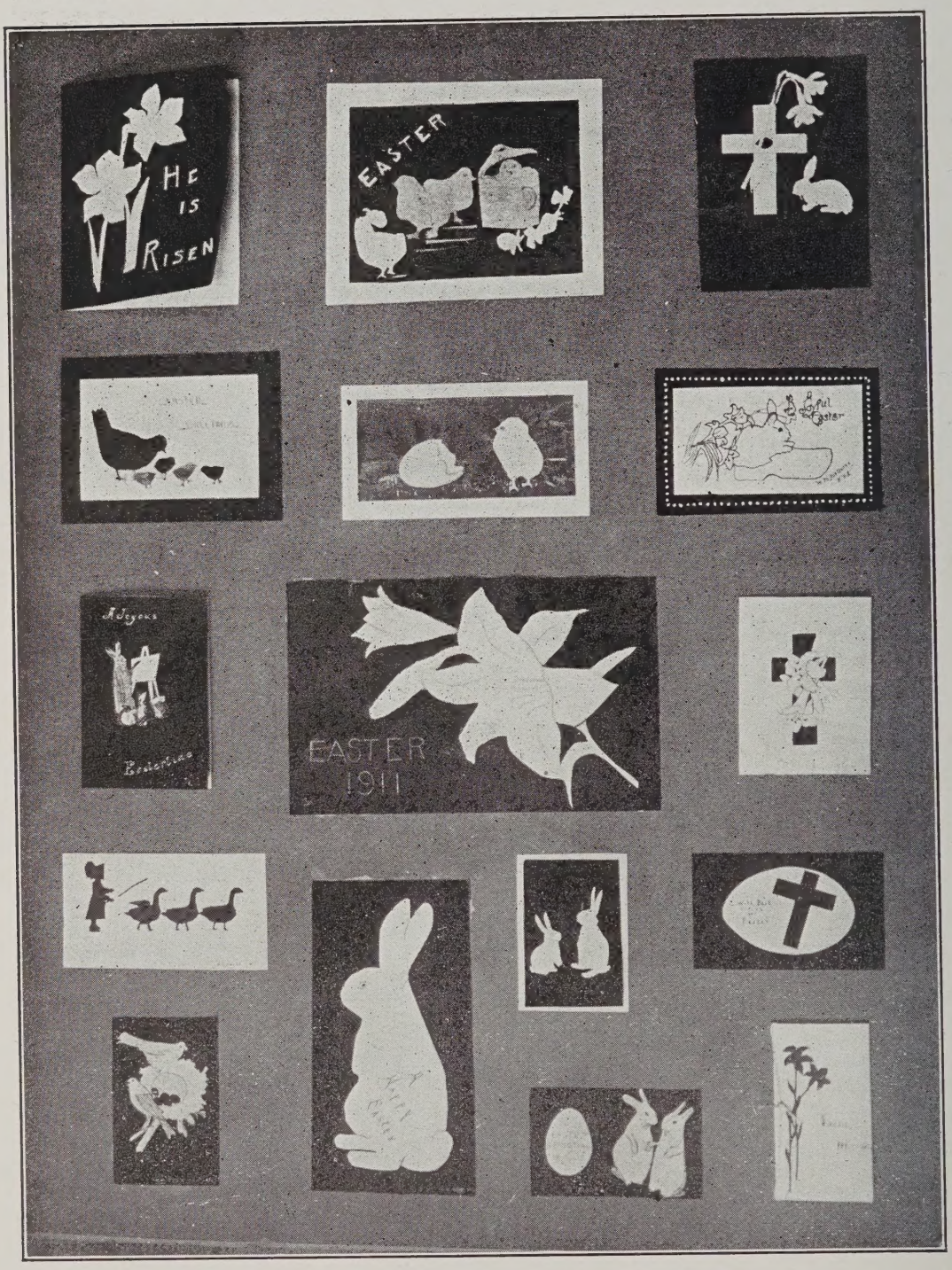


Plate 32.—Paper cutting and mounting illustrations for Easter

TO MY VALENTINE
TO MY VALENTINE
TO MY VALENTINE

Plate 34.—Paper cuttings illustrating Hallowe'en

Plate 35.—Paper cuttings illustrating Christmas

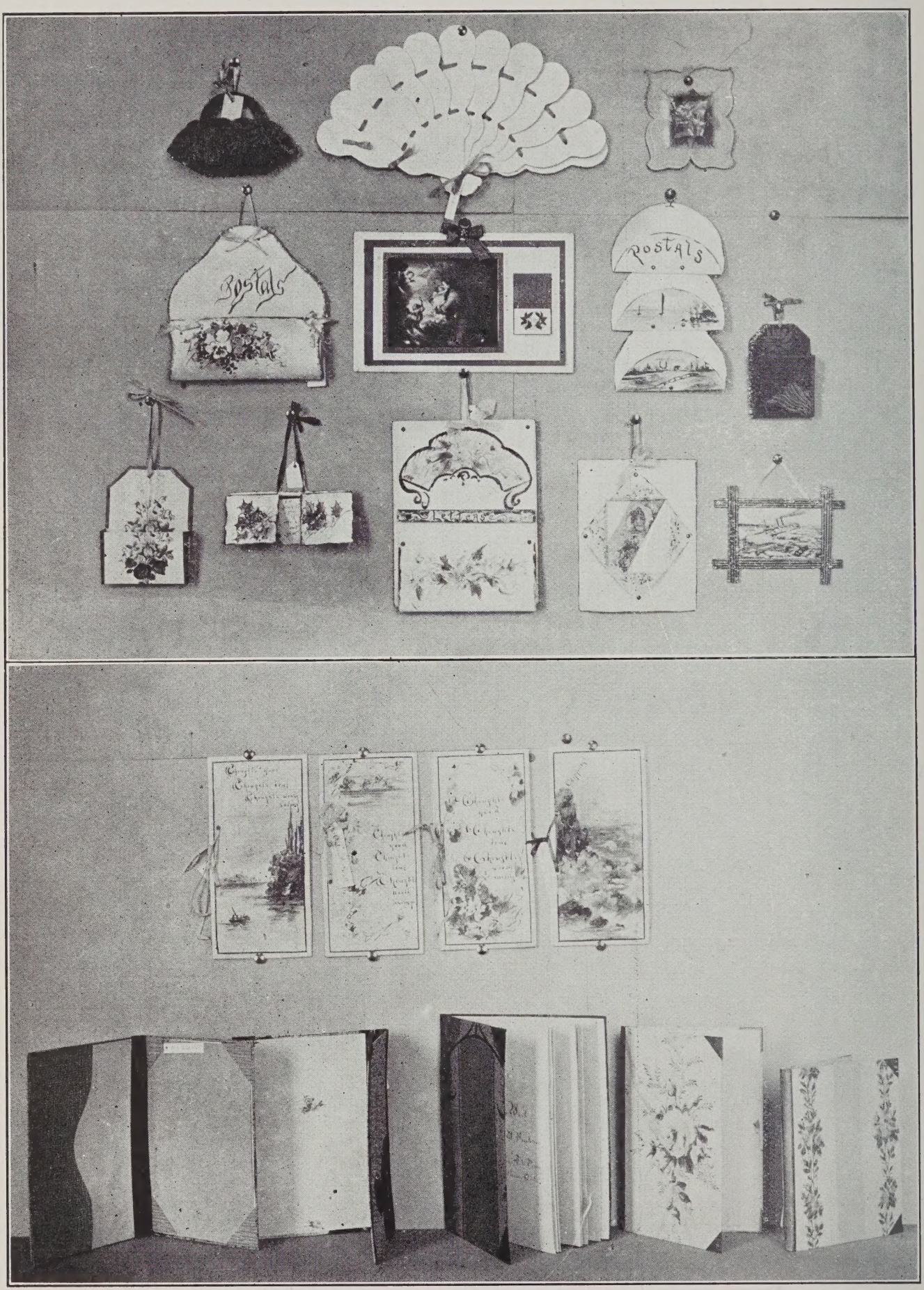


Plate 36.—Decorated cardboard models

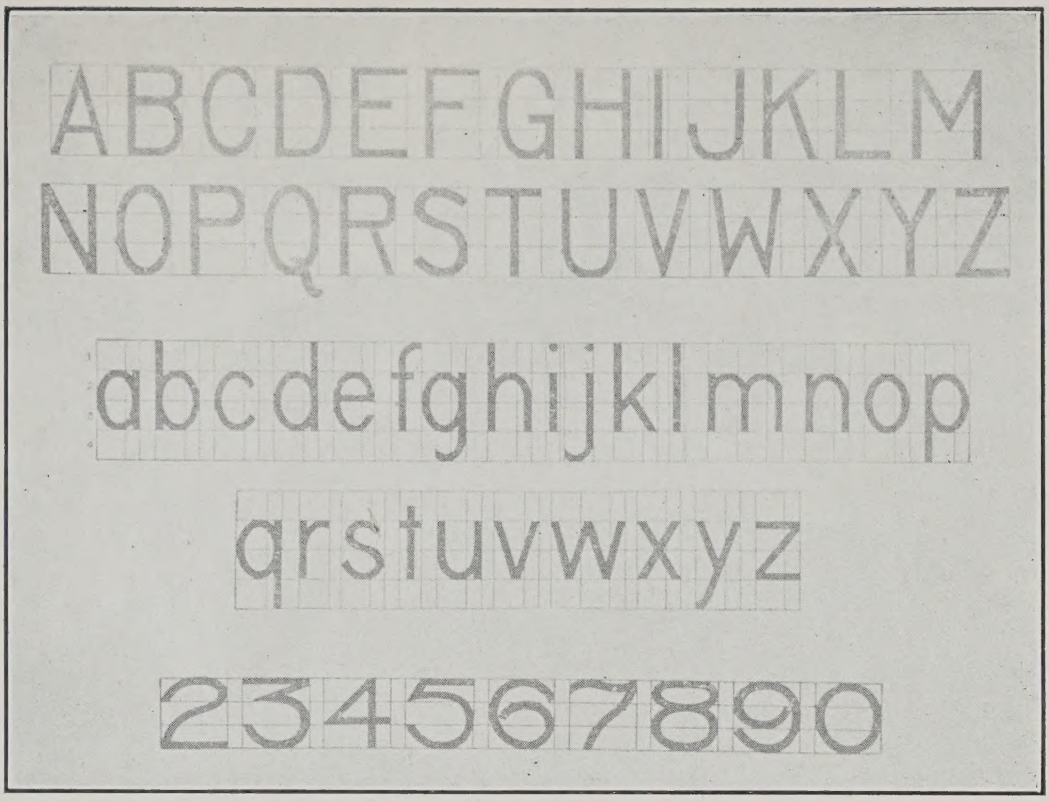


Plate 37.—Letters and figures

Plate 38.—Blue print

INDEX

PAGE

PREFACE 3

INTRODUCTION 5

PUBLIC SCHOOL COURSE OF STUDY (details) 7

MATERIALS AND EQUIPMENT 9
- Plasticine 9
- Clay 10
- Other Equipment Required 10
- Tools 10
- Storing Clay 10
- Storing Clay Models 11
- Mixing Clay Flour 11
- To Prepare Clay from a Natural Clay Bed 11
- To Keep Clay in Good Condition 11
- Modelling Mixtures for Permanent Objects 12
  - Salt and Flour 12
  - Sawdust and Flour 12
- Hints on Working Clay 12
- Armatures 12
- Sand Tables 12
- To Wash Sand 13
- Paper Work 13
  - Engine-coloured Paper 13
  - Tinted Drawing, Construction, and Mounting Paper 13
  - Heavy Folding Paper 13
- Pastes 14
- Materials used with Paper and Cardboard 14
- Cardboard Construction 14
- Thin Wood 15
- Cyanotype, or Blue Print Process 16
- The Printing-Frame 16
- General Wood-work 17
- General Tools 17
- Bench 18
- Raffia and other Materials 19
  - Dyeing 19

Form I. 20
- Free Expression 20
- Modelling in Plasticine—Three Stages 22
  - Lesson on Bead Making 23
  - Materials 23
  - Rolling Plasticine 23
  - Hollowing 23
  - Objects from the Ball 24
  - Designs 24
  - Drawing on Plasticine 24

PAGE

Modelling in Clay 24
Suitable Subjects 24
Illustrative Lesson—the Apple 25

Sand Table 26

Paper Cutting (Six Steps) and Tearing 27
Tearing 27
Cutting Balanced Forms 28
Mounting 28
Class Scrap-Books 28

Paper Folding 28
Objects Based on the Square 28
Illustrative Lesson—the "Checker-Board" 29
Six Exercises 29

Weaving 30
Paper Loom 31
Work in Raffia 31
Winding or Wrapping 32
Mats 32
Braiding 32
Analysis of 32
How to Commence 33
How to Plan Simple Weaves 34
Raffia and Canvas 34

Form II 35
Plasticine and Clay Modelling 35
General Directions for Modelling 35
To Make a Slab 35
Tiles 36
A Circular Dish 36
An Oblong or Square Trough 36

Paper Folding and Cutting 36
Free Cutting 36
Sequence of Foldings—Geometrical Units 37
Sequence of Foldings—Geometrical Shapes from the Square 39
Objects Made from Paper 41
Eleven Exercises 41
Development of a Lesson on a Windmill 42
Illustration of Objects Made from Paper 47

Cardboard Construction 48
Construction of the Square 48
Fourteen Exercises 49
Illustrative Lesson—a Pen Tray 51

Mounting Pictures 54
Pictures 55

Form III 56
Clay Modelling 56

PAGE

Pottery 56
Leaves and Shells 57
Relief Maps 58
Geographical Formations 58
Permanent Relief Maps 59

Paper Cutting 59
Cardboard Construction 59
The Triangle and Rectangle—Thirteen Exercises 59
Decorating 65
Mechanical Drawing 65
Geometrical Problems—Twenty-seven Exercises 65
Scale Drawing—Full, Half, Quarter 71
The Reading of a Drawing 73
The Use of Drawing-Boards, T-Squares, and Set-Squares 74
Plans and Elevations 76
Lettering 79
Work in Thin Wood 80
Five Exercises 80
Illustrations of Objects Made from Thin Wood 83

Form IV. 85
Clay 85
Modelling from Nature 85
Modelling from Casts 85
Design 85
Cardboard Construction 86
Thirteen Exercises 86
Lesson on the Cube 86
Covering 91
Binding 91
Book Covers and Portfolios 92
Cover for Loose Sheets 92
Simple Repairs to Damaged Books 94
Mechanical Drawing 95
Geometrical Problems—Six Exercises 95
Scales 96
Metric Scale 98
Protractor 98
Plans and Elevations 99
General Principles 99
Application of Principle 99
Wood-work 101
Four Exercises 102
Suggestions to Teachers 106
Books for Reference 109
Form V. 112
Course of Study 112
Illustrative Plates 113